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A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LXVIII.—No. 13. ESTABLISHED 1845. NEW YORK, APRIL 1, 1893. $3.00 A YEAR. WEEKLY.

MOVING A BRIDGE BY RAIL.

We illustrate in this issue a very interesting operation, the transporting by rail of a plate girder railroad bridge. The American type of truss bridge is distinctively a built-up, pin-fastened structure, all of whose members are of comparatively light weight. Such bridges are put together *in situ*. The present bridge of the plate girder type represents the English style of riveted construction.

The general appearance of the bridge is shown in the illustration. It is a single track through span skew bridge with center pier. It is carried by four girders of identical dimensions. The girders were put together at the factory, and were taken to the place of erection on cars. This operation is the one which we specially illustrate.

Each girder was 123 feet long and 9½ feet high, weighing 46 tons. To each of them four cars were allotted. The four cars were coupled together, and on the end ones of each group of four cars a framework was laid, comprising three cross members and two longitudinal members. On these frameworks the ends of the truss rested. Thus the weight of the truss was carried by the two end cars only. They were carried by the center transverse members of the frame. To keep them upright, two diagonal braces of wood were arranged at each end. These were secured at the top by a strap crossing the top of the girder. Long bolts ran down by the sides of the braces, binding all firmly together. Short chocks of angle iron on the longitudinal sleepers acted to brace all in place. As the cars took curves, the girders had sufficient freedom of motion to yield to the motion.

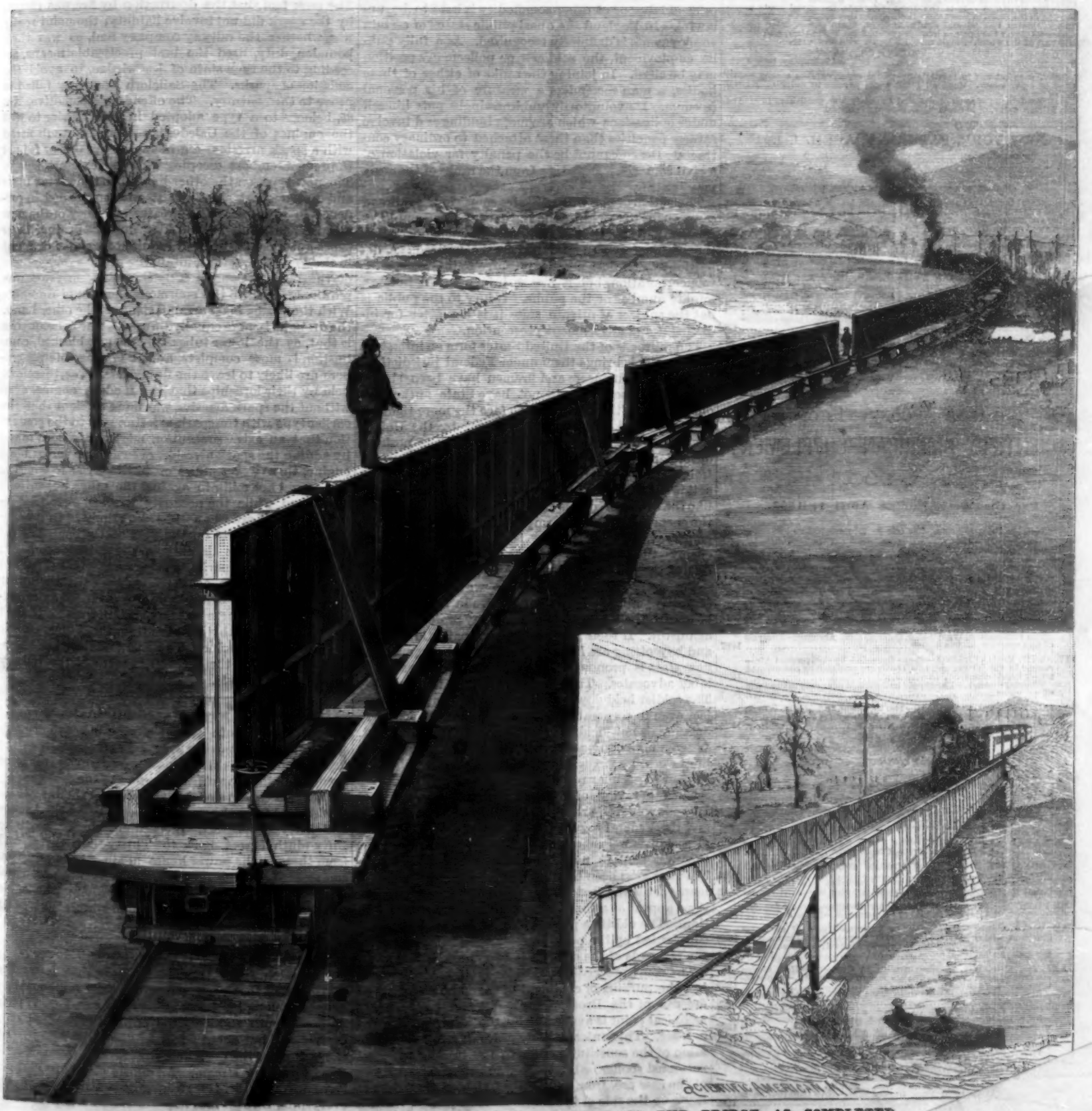
The two middle or intermediate cars were only present as a matter of security, and possibly might be called upon to prevent separation of the end cars if the weight of the girder and its bracing did not develop sufficient coupling power. Thus each end car had to carry a weight of twenty-three tons.

As there were four girders, sixteen cars were used in their transportation. A seventeenth car was included in the train, which car was loaded with the smaller portions of the structure, bolts, tools, etc.

The bridge was built by the Elmira Bridge Company. It was shipped on December 6, 1892, from Elmira to Wallingford Junction on the tracks of the N. Y. C. R. R. and thence *via* R., W. & O. R.R. to Ogdensburg. It reached its destination December 9.

As shipped, the total height from the top of the rail to the top of the girder was about 14 feet 9 inches.

Our thanks are due to Mr. G. H. Thompson, civil engineer of the New York Central Railroad, for information concerning his transportation of this bridge.



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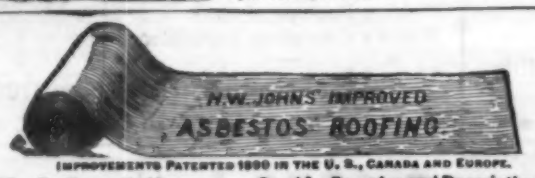

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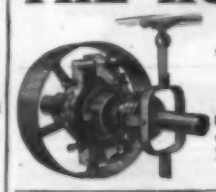

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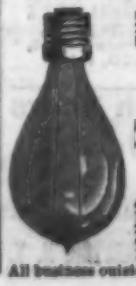

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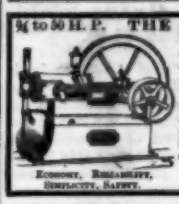

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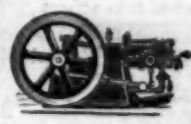

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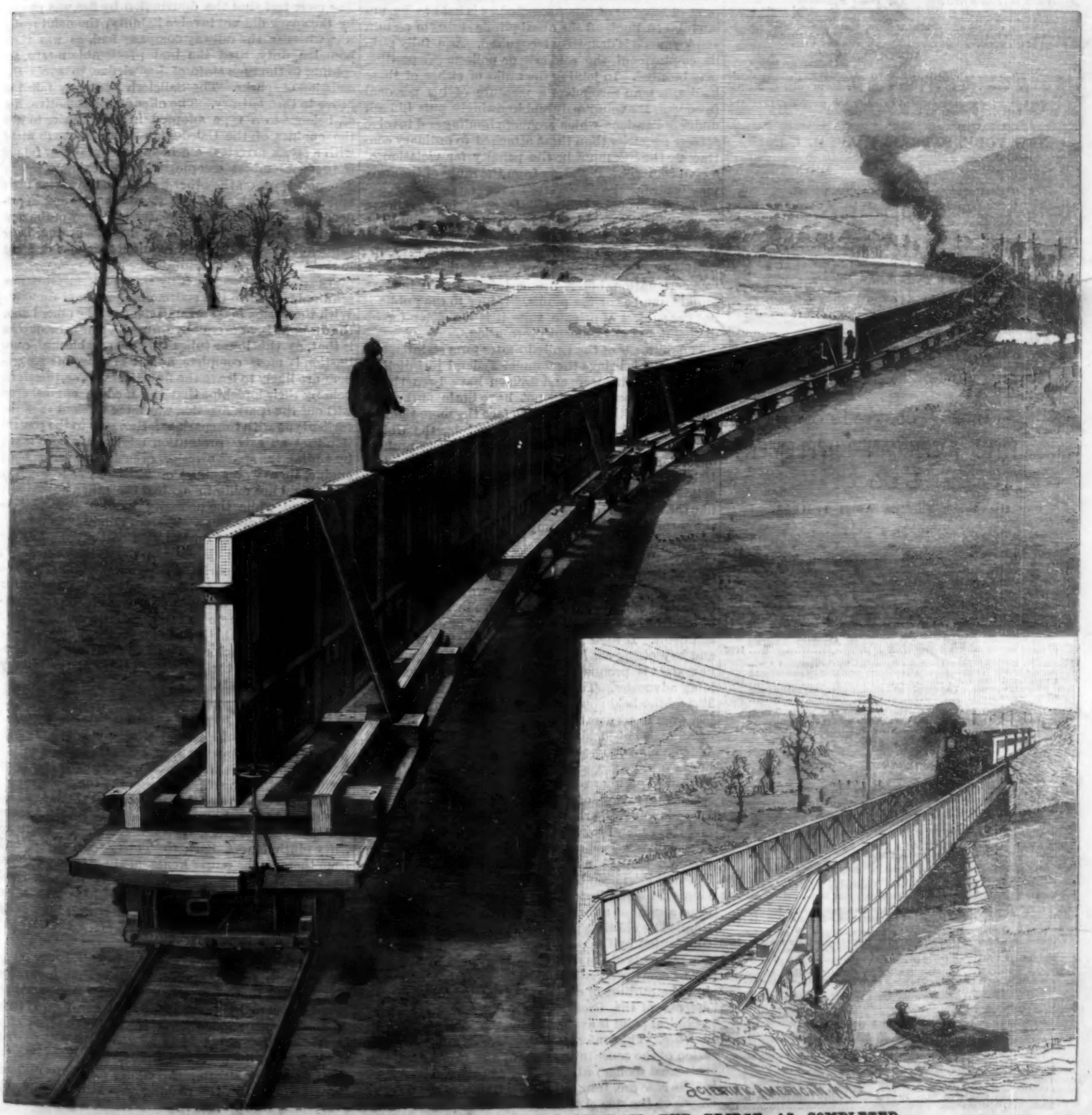

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THE LEGAL STATUS OF RAILROAD EMPLOYES.

A very novel and important action, important, at least, as bringing a much discussed question into the area of judicial action, was taken on Saturday, March 18, in the United States court at Toledo. The engineers on the Toledo, Ann Arbor & North Michigan Railroad had struck. Their places were filled as far as possible with outside men. The Brotherhood of Locomotive Engineers, by their chief, P. M. Arthur, had ordered Brotherhood engineers to refuse to handle cars of non-union and boycotted roads. This amounted to a refusal to handle freight from the Ann Arbor road.

Of course, such action on the part of the sympathizing engineers caused utter derangement of business. The railroad authorities resolved to invoke the Federal powers. They obtained first an injunction from Judge Taft, restraining members of the Brotherhood of Locomotive Engineers from boycotting Ann Arbor freight. A suit for $30,000 damages was also filed against Chiefs Arthur and Sargent for ordering the engineers to strike. Next, the Lake Shore road dispatched a special train to Cleveland and brought United States District Judge Ricks to Toledo, and obtained from him an attachment for three of their fire men and four of their engineers, who had refused to handle the boycotted freight. The men were required to show cause why they should not be prosecuted for contempt of court in face of Judge Taft's previous order.

Locomotive engineers and railroad employes generally occupy quasi-public positions. The public is dependent on them for the carrying out of its business. Under the common law the conspiring to raise the price of labor or of other commodity is held to be unlawful. In England the quasi-public status of certain employments is definitely recognized. As a fully public employment, the soldier's or policeman's position may be cited. In joining the ranks of either of these bodies, a man surrenders a measure of his personal freedom. He voluntarily and knowingly puts himself under obligations which are more binding and involve severer penalties than those attached to ordinary contracts. Death cannot be the penalty for violation of a civil contract. Desertion from the ranks of the army may incur it.

The action of the United States courts in the railroad cases seems to recognize the status of railroad employes as assimilated to that of soldiers. To such operatives the affairs of the community are committed. A detention of cars does not mean injury to one person, or to a corporation, but it means injury to an indeterminate number of the public. Injury to the public is not the subject of private suit—it is a matter for indictment and government prosecution.

The railroads of the United States form an interstate system. This brings them under Federal jurisdiction. The striking engineers and firemen have been shown very clearly that they will not have State authorities only to deal with. They have to face the more rigorous administration of justice as meted out by the United States courts. They are being placed in the position of soldiers of the public. To attempt a boycott of freight, or to conspire in effecting a strike, is by these actions of the courts declared a species of desertion—like the desertion of his colors by a soldier in face of the enemy. The great army of peace, which railroad employes really constitute, is always in face of its enemy—the overcoming of time and space in the interests of the public.

The court's action cuts in two ways. The representatives of labor are inclined to see in it an interference with their personal rights. Many protest strongly against it. If their privileges of sympathetic striking and boycotting are interfered with by the courts, the new state is pronounced slavery by the more rabid labor advocates. This view is of course totally false. The soldier held down to the severest penalties, subject even to corporal indignities, and in some armies to flogging, is not held to be disgraced by enlistment. When a man chooses the railroad as the scene of his life's work, he virtually enlists, and should feel himself subject to peculiar responsibilities and penalties.

The other view of the action of Judges Taft and Ricks involves the recognition by the state of railroads and the Federal regulation of their affairs. One school of socialists welcomes the interference by the courts as the first step in nationalizing the railroad service. This has long been clamored for. The interstate commerce act is the first step. The new injunction motions appear as a further movement in the same direction. The old time private letter expresses have been supplanted by the post office. The parallel course for the railroads of the country is advocated by many.

The court proceedings have for their immediate object the purging of contempt of the employes and the defense of the Brotherhood's officers. Hence every technical point is availed of by the attorneys for the defense. This unfortunately prevents a full determination of the constitutionality of the injunction. But this must sooner or later be adjudicated. The equities of the case are, from the point of view of the public at least, on the side of the railroad. The passengers on a railroad do not relish the idea of the engine crew deserting their engine miles from any settlement and perhaps in weather which may involve sickness and death from exposure to the passengers. The shipper of freight must resent the loss of a market or perhaps the destruction by delay of perishable goods because of the blocking of a railroad by organized action on the part of its striking employes. Such action in the army or at sea would be mutiny. The events we are discussing may make it virtually mutiny on railroads as well.

British Law as to Locomotive Sparks and Fire Raising.

The House of Lords, sitting as an Appeal Court recently, defined the law as to the liability of railway companies for fires caused by sparks from their locomotives. The case was raised, says *Engineering*, by a Port Glasgow Sailcloth Company against the Caledonian Railway Company, the Court of Session having decided in favor of the railway company. The issue was really between fire insurance corporations and railway companies. It was agreed that the fire which consumed the Sailcloth Company's flax store, and involved £12,000 damages, was caused by a spark emitted from Locomotive No. 85 while passing along the Caledonian line contiguous to the stores; but the Lord Chancellor, in giving judgment for the railway company, laid it down that the railway company, having statutory power to run along the line with locomotive engines, which in the course of their running are apt to discharge sparks, it was necessary to prove that the power given was not reasonably and properly exercised, and this the Sailcloth Company had failed to do. The mere fact that the destruction by fire was caused by the spark did not involve liability; the point really was whether the railway company had, as was their bounden duty, used the best practicable means, according to the then state of knowledge, to avoid the emission of sparks. The Sailcloth Company failed to prove to the contrary. The offending locomotive, No. 85, belongs to a type adopted in 1888. Prior to 1882 the engines of the Caledonian Company were fitted with a spark arrester—a grid in the uptake or funnel to prevent embers escaping with the exhaust steam. The new type, on the other hand, has the vortex blast and not a spark arrester. It was contended in evidence in support of the greater efficiency of the new arrangement, that in the old arrangement the lower tubes got blocked up and required a greater draught in the upper tubes to maintain the steam-raising power of the boiler. Consequently the spark arrester was required, owing to the enormous increase of draught. With the vortex blast arrangement, on the other hand, the draught is more equallydiffused. The consequence is that, as the lower tubes do not get blocked, combustion is more complete, and it is alleged fewer embers are likely to leave the fire box. It was, therefore, held by their lordships that the modern engine, even without the spark arrester, was more efficient than the earlier type with the spark arrester. As to the contention that an extra precaution might have been taken by adding the spark arrester, even in the vortex blast engine, there was conflict of testimony as to whether this would not militate against the other advantages mentioned, while the necessity was not clearly established. The Lord Chancellor also admitted that negligence or carelessness on the part of the engine driver would involve the liability of the railway company; but the fact that sparks issued from the funnel did not indicate negligence or carelessness. On the other hand, the engine driver was proved to be an experienced man, and there was no suggestion why he should have departed on this occasion from the ordinary mode of working the engine. The five lords sitting on appeal all agreed in the decision in favor of the railway company, with costs.

Placing a Big Street Car Cable in its Trench.

Over two miles of 1½ inch steel cable of the Broadway Railroad Company was recently placed in the trench beneath the street pavement, where it is to be used in hauling the cars. The end of the cable was attached to a car hauled by twenty-four horses, which was started from the power house at Seventh Avenue and Fifty-first Street, proceeding thence north to Fifty-ninth Street, back to Thirty-sixth Street, and from there to the power house again, where workmen commenced splicing the two ends. At the north and south ends of the space covered, where the cable changes its direction, it runs around wheels twelve feet in diameter.

An Underground Stream.

A dispatch from Augusta, Ill., says that four miles northwest of that place, a few days ago, William Allen bored a well on his farm, going to a depth of 77 feet. At that depth suddenly the entire bottom fell out, carrying all but about 5 feet of the walls with it. At the bottom of the deep hole thus formed could be seen a swift rushing stream. All efforts to fill up this hole have proved futile, the rushing current carrying away everything thrown into it.

POSITION OF THE PLANETS IN APRIL.

SATURN

is evening star. He takes the highest rank on the planetary annals for April, and is in better position for observation than he was during March. He rises now before sunset, and, when it is dark enough for the stars to come out, will soon be high enough above the horizon to make it easy and convenient to observe him with the telescope or the unaided eye. When the month closes, Saturn will be on the meridian about 10 o'clock, and half way between the horizon and the zenith about 7 o'clock. He continues to retrograde or move westward, approaching the beautiful double star Gamma Virginis. He is in conjunction with the star on the 8th, being 6′ south. As 6′ of arc is a very tiny piece of sky, the telescope at that time will bring to view two celestial marvels of wondrous beauty, the ring-girdled planet and the star separated into its two silvery white components hanging side by side in the sky. It is a spectacle that amateurs who have access to telescopes should not fail to see.

The moon is in conjunction with Saturn, two days before the full, on the 28th, at 0 h. 30 m. A. M., being 50′ south. The conjunction will be visible as an appulse, and there will be an occultation of the planet in the southern hemisphere for observers who are in the right conditions to see it.

The right ascension of Saturn on the 1st is 12 h. 38 m., his declination is 1° 11′ south, his diameter is 18″.2, and he is in the constellation Virgo.

Saturn sets on the 1st at 5 h. 51 m. A. M. On the 30th, he sets at 3 h. 53 m. A. M.

URANUS

is morning star until the 28th, and then evening star. He is in opposition to the sun on the 28th, at 7 h. 28 m. P. M., being at his nearest point to the earth, and reaching the meridian about midnight. These are the most favorable conditions under which he is ever seen, and the opportunity should be improved by observers who wish to follow his course, for he is barely visible to the naked eye in his best estate. It is easy to keep track of the distant wanderer, his movement is so slow, for it takes him seven years to pass through a zodiacal constellation. The bright star 18° northwest of Uranus is Spica, the third magnitude star on the east is Alpha Librae, the fifth magnitude star on the west is Lambda Virginis. The last time the planet traversed the portion of sky he occupies at present was in 1809, and he will not return to it again till 1977. The best period of observation for Uranus is from March till August.

The moon, two days after the full, is in conjunction with Uranus on the 3d, at 10 h. 34 m. A. M., being 1° 36′ south. The conjunction is invisible, occurring in the daytime.

The right ascension of Uranus on the 1st is 14 h. 30 m., his declination is 14° 19′ south, his diameter is 3″.8, and he is in the constellation Libra.

Uranus rises on the 1st at 8 h. 34 m. P. M. On the 30th, he sets at 4 h. 59 m. A. M.

JUPITER

is evening star until the 27th, and then morning star. The planet will be conspicuous by his absence from the sky. His reign has been long and brilliant, and his bright presence as evening star will be greatly missed, not only for his superb appearance, but for the record he has made, the jewel added to his starry crown. Very few observers will see the mythical fifth satellite, but every one interested in astronomy knows and feels its presence close beside the grand primary.

Jupiter is in conjunction with the sun on the 27th, at 7 h. 8 m. P. M. He then passes to the sun's western side, commencing his career as morning star, being for the present too near the sun to be visible. An interesting incident marks his course. He is in conjunction with Venus on the 28th, at 11 h. 39 P. M., being 8′ south. Jupiter, the day after conjunction, a one-day-old morning star, moving westward from the sun, encounters Venus moving eastward toward the sun, only four days before her superior conjunction with the sun. The planets are close together, and close to the sun. They have their meeting, make their appulse, and go on their way, the phenomenon as totally invisible to terrestrial observers as if the two brightest planets had dropped from the sky. Imagination has power, however, to pierce the solar veil and behold the picture securely hidden within the royal vestibule.

The moon, the day after her change, is in conjunction with Jupiter on the 17th, at 0 h. 13 m. A. M., being 1° 44′ north. The conjunction is invisible for two reasons. Moon and planet are below the horizon, and are too near the sun to be seen.

The right ascension of Jupiter on the 1st is 1 h. 59 m., his declination is 11° 8′ north, his diameter is 32″.0, and he is in the constellation Aries.

Jupiter sets on the 1st at 7 h. 53 m. P. M. On the 30th, he rises at 5 h. 0 m. A. M.

VENUS

is morning star. The only interesting event in her April course is her close conjunction with Jupiter, already described. She is of no account for nearly three months to come, after which she will emerge from her retreat and shine brightly as evening star.

The moon, on the day of her change, is in conjunction with Venus on the 16th, at 2 h. 44 m. A. M., being 42′ north. The conjunction is invisible.

The right ascension of Venus on the 1st is 0 h. 18 m., her declination is 0° 21′ north, her diameter is 10″.0 and she is in the constellation Pisces.

Venus rises on the 1st at 5 h. 32 m. A. M. On the 30th, she rises at 5 h. 2 m. A. M.

MERCURY

is morning star. On the 28th, at 9 h. 8 m. P. M., he reaches his greatest western elongation, when he is 26° 56′ west of the sun. He may then be looked for in the east before sunrise as morning star visible to the unaided eye. The success of the observer is uncertain, as the planet is 12° farther south than the sun.

The moon, two days before her change, is in conjunction with Mercury on the 14th at 8 h. P. M., being 1° 39′ south.

The right ascension of Mercury on the 1st is 0 h. 36 m., his declination is 6° 50′ north, his diameter is 11″.4, and he is in the constellation Pisces.

Mercury rises on the 1st at 5 h. 27 m. A. M. On the 30th, he rises at 4 h. 7 m. A. M.

MARS

is evening star. He has dwindled to a ruddy point, and will soon be lost to sight. The planet is so small that he is only seen to advantage at opposition and during the month before and after. He is not in opposition in 1893, and observers must turn their attention to more interesting members of the sun's family. His synodic period, or time from one opposition to the next, is 780 days, or 2 y. 1¼ m., the longest in the planetary system. The earth, therefore, revolves twice around the sun, and it then makes 1¼ m. of a third revolution before she comes into line between the sun and Mars.

The moon, three days after her change, is in conjunction with Mars on the 19th, at 2 h. 31 m. P. M., being 2° 45′ north.

The right ascension of Mars on the 1st is 4 h. 1 m., his declination is 21° 39′ north, his diameter is 5″.0, and he is in the constellation Taurus.

Mars sets on the 1st at 10 h. 36 m. P.M. On the 30th, he sets at 10 h. 15 m. P.M.

NEPTUNE

is evening star. His right ascension on the 1st is 4 h. 30 m., his declination is 20° 19′ north, his diameter is 2″.6, and he is in the constellation Taurus.

Neptune sets on the 1st at 11 h. 0 m. P.M. On the 30th, he sets at 9 h. 9 m. P.M.

Mars, Saturn, Neptune and Uranus are evening stars at the close of the month. Mercury, Venus and Jupiter are morning stars.

TOTAL ECLIPSE OF THE SUN.

There will be a total eclipse of the sun on the 16th, invisible in North America, but visible as a partial eclipse in nearly the whole of South America, nearly the whole of Africa, and portions of Europe and Asia. The path of totality commences in the Pacific Ocean, traverses the central part of South America, crosses the Atlantic Ocean, and ends in the center of Africa. The central eclipse begins in Greenwich mean time, on the 16th, at 0 h. 54 m. P. M. The middle of the eclipse occurs at 2 h. 27 m. P. M. The central eclipse ends at 4 h. 19 m. P. M. Observers on the line of totality will behold the most magnificent phenomenon ever visible from this planet, when for a few moments the sun's face is hidden from view.

The conditions required for a total eclipse are that the moon shall be at her nodes or crossing points when at new moon. She must be near perigee when her diameter is greatest, and the sun near apogee when his diameter is least. These conditions are fulfilled in the present eclipse. The moon is near her node, and near perigee, and the sun is approaching apogee. The moon's diameter is 33′ 7″.0. The sun's diameter is 31′ 55″.4. The moon's diameter exceeds the sun's 1′ 11″.6. The result is that the eclipse will occur under very favorable circumstances, the totality lasting at some points of observation 4 m. 42 s., making the eclipse one of the finest of the nineteenth century, for its comparative accessibility and the length of its continuance.

The eclipse will call out more observers than were ever assembled before. American and European astronomers are already making preparation for the great event at the stations they have chosen. Some are located at Ceara, on the northeast coast of Brazil, many are in the region of the Senegal in West Africa. The path of totality has been carefully mapped for observers to choose the localities best adapted to their special work. The whole astronomical world is greatly exercised with the hope of making discoveries within the solar precincts.

Much is expected from the condition of the sun, now at the maximum of sun spots. The sun's circumference will be aflame with rosy protuberances, and the silvery corona show signs, by its greater extent and more radiant glow, of the disturbances that agitate the sun and are reflected on the earth in magnetic storms and vivid displays of auroral light. If only the weather be propitious and the wearisome travel and great expenditure be not in vain!

Agricultural Notes.

The relative merits of sweet cream and sour cream for making butter were tested last year in a series of elaborate experiments at the Iowa Agricultural College. Sweet cream, fresh from the separator, was thoroughly mixed and then accurately divided in two equal parts by weight; one of these parts was churned immediately at 52° F., the other was ripened at 60°, and then churned at 59°. The butter-milk was tested for fat, and the butter was analyzed. In the nine tests the yield of butter from sour cream was 3 per cent larger than from sweet cream. The sour cream usually churned quicker than the sweet, and the butter contained 2-100 of 1 per cent more casein. The losses of fat in churning, washing, and working were less with sour than with sweet cream. In nine trials the average difference was nearly ½ lb. per 100 lb. of butter made. After being kept five months the sweet cream butter acquired somewhat of the flavor and aroma of ripened cream butter, and was in better condition.

A very interesting series of tests have been made at the Wyoming experimental station to determine the quantity of water necessary to irrigate an acre of land. A continuous flow of one cubic foot per second during May, June, July, and August was found sufficient, with a rainfall of about six inches, for over 95 acres of land which had never been irrigated; but the next year, with a rainfall of nearly seven inches, it would have sufficed for over 216 acres of such previously irrigated land. The need of water varied with the kind of crop. Thus one second foot through the four months would have supplied 167 acres of oats, 295 acres of sugar beets, 336 acres of sorghum, 588 acres of peas, and 735 acres of corn, all growing on land close to the irrigation canal. The previously estimated duty of water for Wyoming was about 100 acres to the second foot through four months.

Some very interesting experiments have been conducted at the Texas experimental station, the object having been originally to see whether the belief of many farmers that cottonseed would kill pigs under certain conditions was well founded. The two years' successive tests in feeding cottonseed and cottonseed meal to pigs, and practical attempts to feed these products during the last ten years, show that there is no profit in feeding cottonseed in any form, or cottonseed meal, to pigs of any age, and a good deal of danger.

The Acids of Fruits.

Mr. George W. Johnson, in his *Chemistry of the World*, says in describing the "vegetable food of the world:"

"The grateful acid of the rhubarb leaf arises from the malic acid and binoxalate of potash which it contains; the acidity of the lemon, orange, and other species of the genus *Citrus* is caused by the abundance of citric acid which their juice contains; that of the cherry, plum, apple, and pear, from the malic acid in their pulp; that of gooseberries and currants, black, red and white, from a mixture of malic and citric acids; that of the grape from a mixture of malic and tartaric acids; that of the mango from citric acid and a very fugitive essential oil; that of the tamarind from a mixture of citric, malic, and tartaric acids; the flavor of asparagus from aspartic acid, found also in the root of the marshmallow; and that of the cucumber from a peculiar poisonous ingredient called fungin, which is found in all fungi, and is the cause of the cucumber being offensive to some stomachs. It will be observed that rhubarb is the only fruit which contains binoxalate of potash in conjunction with an acid. It is this ingredient which renders this fruit so wholesome at the early commencement of the summer, and this is one of the wise provisions of nature for supplying a blood purifier at a time when it is likely to be most needed. Beet root owes its nutritious quality to about nine per cent of sugar which it contains, and its flavor to a peculiar substance containing nitrogen mixed with pectic acid. The carrot owes its fattening powers also to sugar, and its flavor to a peculiar fatty oil, the horse radish derives its flavor and blistering power from a volatile acrid oil. The Jerusalem artichoke contains fourteen and a half per cent of sugar and three per per cent of inulin (a variety of starch), besides gum and a peculiar substance to which its flavor is owing; and lastly garlic and the rest of the onion family derive their peculiar odor from a yellowish, volatile acrid oil, but they are nutritious from containing nearly half their weight of gummy and glutinous substances not yet clearly defined."

O. D. M.—In answer to the question, "How would a hot water boiler work connected with two ranges, one in basement and one on first story, with boiler on second story?" the *Plumbers' Trade Journal* answers:

It will work all right if properly connected. Run your cold water pipe first to lower range, then with hot pipe to upper range—this will act as a superheater. If a large quantity of hot water is required, it will be a good way to supply the demand; otherwise you will create steam. If run any distance, put in a return pipe to system.

AN IMPROVED CAMERA LUCIDA.

The camera lucida, that wonderful instrument invented by Wollaston in 1804, as well as the numerous improvements that have been introduced into it, still leaves much to be desired, in consequence of the disagreeable phenomenon of parallax that is produced in all the apparatus now in use. This phenomenon, which is due to the different distances that separate the eye from the object and the pencil, is completely suppressed in the new camera lucida of Commandant H. Blain. Moreover, it is always possible to proportion the light of the paper and that of the image that is projected upon its surface. It suffices to vary the intensity of the light furnished by the silvered mirror, by placing a platinized mirror opposite it.

Fig. 2.—METHOD OF USING THE APPARATUS.

The hemerograph, for such is the name of the new instrument, is a very practical device that can be used without the least study. The drawing can be done without hesitation, the eye accommodates itself to all distances, and the point of the pencil and the image are always seen very distinctly.

The field of this apparatus is indefinite. It is used in a horizontal as well as in a vertical direction and at variable angles. It suffices to give a rotary motion to one of the mirrors that compose it in order to discover parts that remained invisible in a preceding position.

The hemerograph consists principally of two special mirrors of a perfect planimetry, arranged in a mounting of copper.

The upper, silvered mirror is provided in the center with an aperture that serves as a sight hole when the apparatus is placed horizontally. It is provided at its upper part with a second sight hole designed to be employed in a vertical direction (Fig. 1).

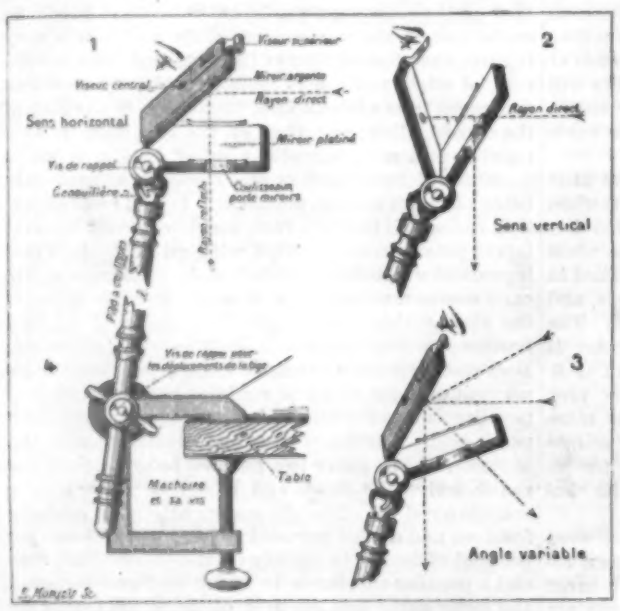


Fig. 1.—DETAILS OF BLAIN'S HEMEROGRAPH.

The lower mirror, metalized with platinum, possesses a calculated transparency that permits of seeing the pencil and object always very distinctly and without any fatigue to the eye. This mirror is movable and may be replaced by a smoked one when work is being done in sunlight.

This apparatus is supported by an extensible foot provided with a joint that permits of its being raised or lowered according to circumstances, and of being turned in all directions.

Finally, if the instrument be placed before a telescope or a simple field glass, it will be possible to draw on a large scale an object situated at a distance of several kilometers, according to the power of the spy glass, just as if it were placed at a few meters from the observer. This means will be able to render very great service to officers sent out upon a reconnaissance.

In order to place the instrument in position, as shown in Fig. 2, the jaws are fixed to a table, the extensible foot is adapted to it, and the mirror supports are installed upon the joint. By acting upon the binding screw, the foot is placed at the point desired, and the apparatus is ready to operate. It is necessary, then, to open the mirror supports, and when the foot is at the proper point to well expose the object, it is arrested by its adjusting screw. The instrument may be used with both eyes or one only. The play of the mirrors is so simple that after a first trial one will be master of the instrument.

Fig. 1 shows the method of using the instrument in the three directions: (1) horizontal; (2) vertical; and (3) at a variable angle. If it is used at a variable angle, the metalized mirror must be placed upon the lower edge of the cap of the spy glass, and the silvered mirror be brought to the angle most favorable for receiving the direct ray. The eye is placed as in the figure.

Enlargements can be obtained by interposing a convex lens between the apparatus and the objective, and, according to circumstances, between the apparatus and the paper. In order to obtain enlargements with a convex lens, the latter must be placed in the screw bolt fixed to the table, and brought to a focus by raising it or lowering it upon its slide, and the image or object be placed at about 15 centimeters behind.—*Le Nature.*

A RECENT IMPROVEMENT IN BUCKLES.

The form of buckle shown in the illustration is designed to replace older varieties of buckles wherever a buckle is needed, and is particularly adapted to adjustably connect parts of harness for draught animals. It has been patented in the United States and Canada by Mr. George M. Aylsworth, of Collingwood, Canada, and a patent has been applied for in England. It is believed the new buckle will do away with the hand stitching now required to form an adjustable connection or joint between two or more pieces of leather, as these buckles are attached by means of rivets, and the tongue plate takes the place of the old form of keeper loop, as shown in Fig. 2. The frame of the buckle consists of a sheet metal blank secured to the strap by rivets, and with bent-up side flanges, in which, at one end, is a transverse pintle carrying a spring-pressed keeper plate. A tongue, formed of a rivet, is secured in the keeper plate, the tongue being adapted to pass through a strap and have a locking engagement with an opposite perforation in the web plate of the frame, as represented in Fig. 1, where the buckle is shown in use to make an ordinary joint. The buckle is convenient to adjust, and simple and cheap in construction, obviating the need of a keeper or loop on the strap to prevent the flapping of the end of the strap, and it is also very light, strong and neat in appearance. An affidavit of a practical harness manufacturer, familiar with the new buckle, sets forth that in his opinion a man will, with this buckle, make a set of harness in about half the time required with the old form of buckle.

Library Mutilators.

Among the notable institutions of New York is the Astor free library, where many thousands of volumes of the most important books, especially works of reference, are to be found. Any visitor may there consult a convenient index, call for the desired volume, and take a seat at a table. The work will shortly be brought to him by a polite attendant, and there he may sit and read for hours at a time. Most of the people who go to the Astor appreciate the benevolence of the founders of the institution and are careful to preserve the books intrusted to their temporary use. But there are some persons—two-legged skunks they might be called—who are mean enough to mutilate the books. They cut out and steal pages or parts of pages, which they are too indolent to copy, and manage to sneak out of the library undetected. One of the books in greatest demand is the "Scientific American Cyclopedia of Receipts, Notes and Queries." We are frequently asked by the librarian to replace such mutilated and missing pages. It is a pity that the book mutilators cannot be caught and punished.

AN IMPROVED CAR AXLE BOX.

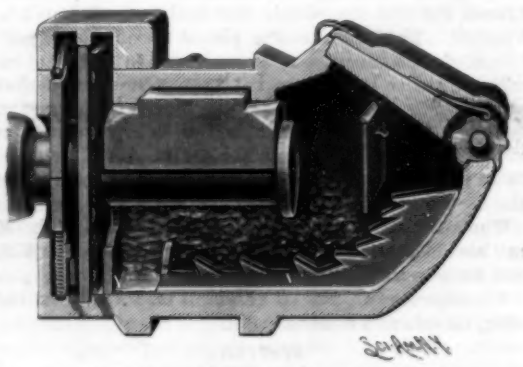
The axle box shown in the illustration is provided with an improved sponge holder, has a novel spring closer for the lid of the box, and improved means to prevent the escape of oil from the box at its inner side. It has been patented by Messrs. William Rader and Edwin Hunter, Allentown, Pa. A center scroll on the lid is introduced between side scrolls in the box body, detent disks with scalloped edges at the inner end walls of the side scrolls retaining the lid open or closed, by engagement of the notched edges with the body of a core rod secured in the scrolled end of a locking spring. The arrangement is such that the lid may be held at different points of open adjustment or in closed

AYLSWORTH'S BUCKLE.

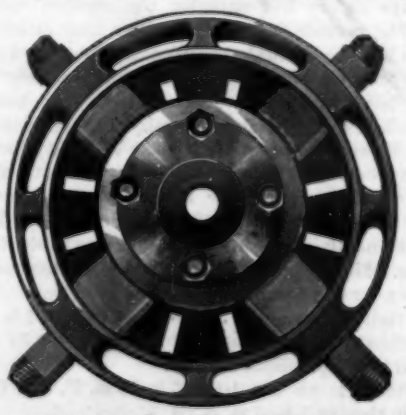
position. The shell forming a bearing for the axle journal is of the usual form, and in the bottom of the sponge-holding cavity below the journal is a shoe, readily inserted through the lid opening, the shoe having on its upper face ribs with serrated edges to sustain a mass of sponge at the front end of the journal. At the front top edges of the ribs is a vertical gate, held in side grooves of the box, to assist in keeping the sponge in place, and at the inner end of the box, in transverse slots, are pairs of sliding spring-pressed plates and gates preventing the escape of any lubricating material.

AN INDEPENDENT LATHE CHUCK.

The Westcott Chuck Co., of Oneida, N. Y., will not only have a large exhibit of its goods at the World's Fair, Chicago, but it is supplying, upon order from the Columbian Commission, the chucks that are to be used in a large model machine shop adjoining Machinery Hall. The accompanying illustration represents an entirely new independent lathe chuck, recently got out by the company, and for which a patent has been issued to Mr. James H. Westcott. It is very strong, because the end thrust and strain come on the chuck body at its strongest points. Each jack screw has a steel carrier threaded on one side and fastened by a set screw, half of the screw having a bearing on the carrier and the other half having a bearing in the body of the chuck. The thrust is thus distributed so as not to spring or break the chuck body, and the screw carriers are adjustable. The range of adjustment of the jaw carriers is also greatly augmented, as compared with other independent chucks, thus giving much greater capacity. In case of wear the carriers can be renewed at a small cost. All parts are interchangeable, and the jaws can be removed and the chuck body used as a face plate. The chuck is furnished with either two, three, or four jaws, or with special jaws.



RADER & HUNTER'S CAR AXLE BOX.



WESTCOTT'S "I X L" LATHE CHUCK.

IMPROVED RUBBER TOYS.

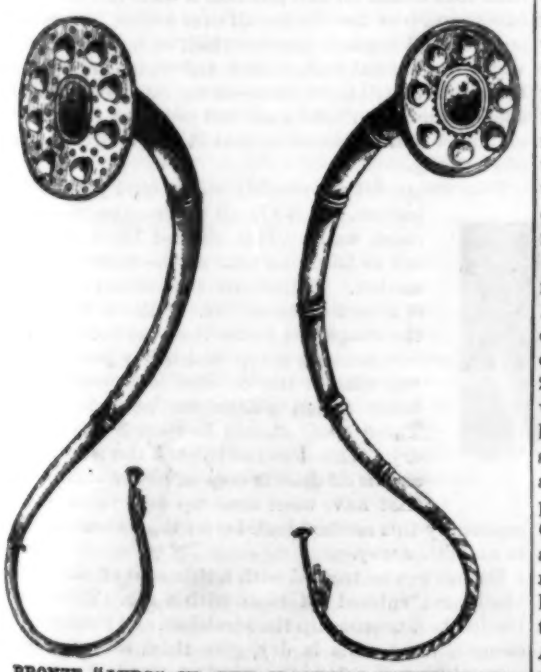
Rubber toys, on account of their durability and harmlessness, have long been a staple article, and are to-day found in the shops in much the same form as they were a dozen years ago. An improvement in this line, designed to give a new impetus to these goods, has lately been patented by Mr. Orville Carpenter, of Pawtucket, R. I., and by means of which such toys, when intended to represent images of human beings

CARPENTER'S RUBBER TOY IMPROVEMENT.

and animals, can be made to illustrate the most marvelous peculiarities without adding to the cost of production. This improvement consists in making these hollow images of varying thicknesses of rubber, so that when squeezed by the hand the thinner parts expand out of all proportion to the rest of the image, producing an endless variety of grotesque and ludicrous variations of the same image, according to the amount of compression given by the hand. The accompanying illustration represents one of these toys, Fig. 1 showing it in its normal state and Fig. 3 as the parts are distended when the toy is slightly squeezed by the hand. The thinness of the rubber at the eyes, nose, and chin is indicated in the diagram view, Fig. 2. It will be seen that this invention offers a wide range for the skillful designer in this line of goods, as by simply varying the thickness of the rubber in different parts of a toy startling results are made to appear by a simple squeeze of the hand.

THE OLDEST MUSICAL INSTRUMENTS.

The National Museum in Copenhagen, which is so well known and renowned for its excellent and admirably arranged collections of northern antiquities, contains a number (19) of a kind of musical instrument called the "*lur*" (the *u* pronounced like *oo* in poor), which date back to the bronze age, and which have all been found in bogs, as have also so many others of the old treasures contained in that interesting museum. A few instruments of the same kind (8) have



BRONZE "LURS" IN THE NATIONAL MUSEUM IN COPENHAGEN.

been found in provinces in Sweden formerly belonging to Denmark, and five have been found on the Baltic coast of Germany nearest to Denmark. There is nothing like this instrument elsewhere in the world. An instrument used in parts of the East Indies at the present day is the nearest approach, in some respects, but it varies very materially from the "*lurs*."

The outward appearance of the "*lur*" is represented in the adjoining cuts. It is generally six or seven feet long, twisted in two planes perpendicular on one another, and furnished with an ornamental collar at the butt or farther end. It is cast from a kind of bronze, only one to one and a half millimeters thick. (Could we do this at our present day?) To increase the difficulty of construction, it is perfectly conical from end to end, cast in pieces, and joined together as indicated in the adjoining illustrations, and, as already stated, of a twisted shape.

All the instruments of this kind found outside of Denmark are more or less fragmentary. Of the specimens in the Danish collection ten are whole, and of these again six have just been slightly restored under the auspices of the author and musical critic, Angul Hammerich, who has caused some artist musicians from the royal chapel to experiment with and practice on the restored specimens, with the very interesting result that these can now be played upon and emit tones as pure, strong and soft as when they were first touched with human lips, between 2,000 and 3,000 years ago. Well may we wonder at the constructive skill, the perfect knowledge of acoustics and the state of civilization in those remote times evinced by these old instruments. It is, of course, the preserving power of the bog water which we may thank for the perfect preservation of these unique instruments.

The bogs in which the "*lurs*," and so many other interesting objects from northern antiquity, have been found have, of course, at the time of deposit of the objects, been lakes or ponds. How the objects came to be placed here may be subject to varying surmises; the most probable is that they have been sunk down in such places to protect them from some invading enemy. Some authorities on this kind of subjects hold to the opinion that the objects have been brought as sacrifice to friendly or unfriendly gods, which supposition also seems quite likely.

The instruments are always found in pairs and twisted in opposite directions, indicating that they have been blown two and two together. This is so much more certain as the specimens of each pair harmonize with one another, while each pair varies more or less from every other pair in quality of tone, etc. It was formerly believed that the "*lurs*," when played upon, were resting over the player's neck and shoulders. They have occasionally been thus represented by artists. This Mr. Hammerich has proved to be a mistake. They were carried or held free in front of the players, with the ornamental butt collars facing one another, when the players were blowing them, standing or marching side by side, in which position the instruments balance easily and make a very odd and striking appearance, as of two gigantic and fantastically twisted horns of some fancied animal.

A few days ago the writer of this communication had the good luck and great pleasure to attend a fascinating lecture on the "*lurs*," by Doctor Hammerich, accompanied by experiments of two artist musicians, at the grand old style knights' hall of the National Museum in Copenhagen. Not only were military signals blown with great effect, but entire small compositions were performed. It was indescribably interesting to listen to the performance of an air from one of our most popular romantic plays. The intelligent reader with a measure of imagination may to some extent realize the impression it must convey to hear fanciful music performed on instruments which some 3,000 years ago were used at strange temple services, or on triumphal war marches, or as accompaniment of the songs and recitals of the heathen bards or scalds at the courts of kings and chiefs, or at great national feasts.

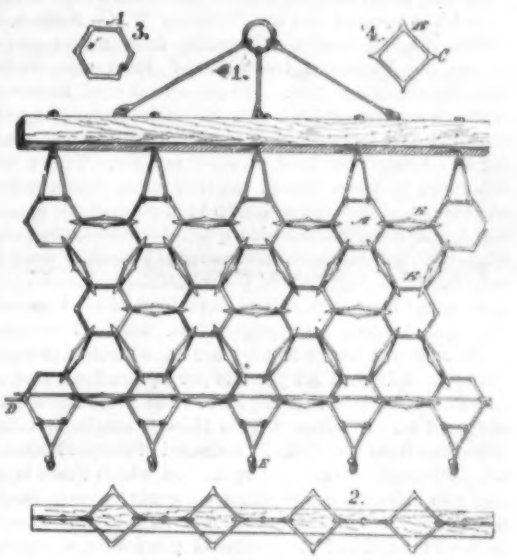
What an attraction it would be for the visitors of the Columbian Exposition at Chicago if their ears could be feasted with actual music or musical tests from instruments 2,000 or 3,000 years old! But this will hardly come to pass. Doubtless an attempt will be made to secure the bait, but our Danish authorities will hardly give their permission, and who can wonder! Our "Flatö Book" will be fetched and returned with appropriate ceremonies in a U. S. man-of-war. A house will be built for the book telling of the first discovery of America, *via* Greenland, a thousand years ago, and watch will be kept over it night and day. All very well! As to the "*lurs*," we shall see. J. PEDERSEN-BJERGAARD.

Copenhagen, Denmark, January 10, 1893.

HYDROFLUORIC acid is manufactured by heating a mixture of 1 part of fluorspar in powder with 2 parts of sulphuric acid. The reaction is conducted in a leaden still, to which a head and a receiver of the same metal are attached. In the receiver is placed a gutta-percha dish containing water which absorbs the fumes.

AN IMPROVED HARROW.

The simple and inexpensive harrow shown in the picture, and which has been patented by Messrs. Samuel Riley and William Evans, of Huron, Kansas, may be easily carried to and from the field, and may be stored in small space when not in use. It is essentially a chain harrow, the teeth and their supports partaking of the character of links. In eyes or hooks in the rear of the draught beam are held pivoted yokes,

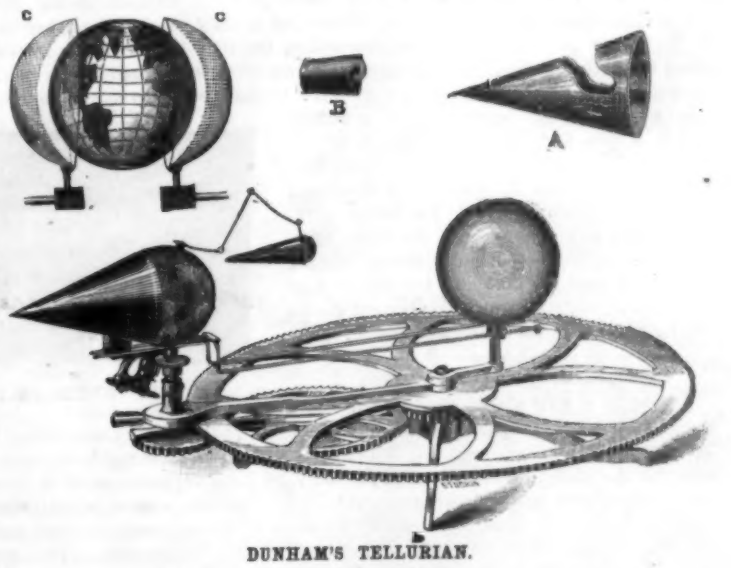


RILEY & EVANS' HARROW.

which engage the tooth supports, A, the latter engaging the harrow teeth, B, to hold them in a horizontal or in a diagonal position, as shown in Fig. 1. Each of the teeth-supporting links, A, Fig. 3, has its ends recessed to be fitted together and welded when desired, and each of the teeth, B, Fig. 4, has four spurs, C, adapted to enter the ground, so that if any one of the prongs should become worn another may be turned down. Fig. 2 is an end view of one row of teeth. A tension bar, D, extending transversely across the last row of tooth supports, holds the chain-like body of the harrow in extended position ready for work, and this last row of supports terminates in hooks, E, adapted to connect a second harrow section to the first if desired. The harrow being made in detachable sections, it can be handled with great facility, sections being added as desired, and, as the teeth are set alternately parallel and diagonal to the draught beam, the ground is very efficiently stirred and pulverized, and the surface left smooth.

A TELLURIAN FOR THE HOME AND SCHOOL.

The illustration shows a mechanical representation of the sun, earth, and moon, so arranged that, by taking hold of the handle below and near the earth, the latter can be moved to imitate its yearly motion around the sun, at the same time turning on its axis as in its diurnal motion, the moon simultaneously revolving around the earth and rising one hour later each night. The sun is placed eccentrically within the earth's orbit, and the earth's poles are inclined to the plane of the orbit, thus illustrating the seasons and the long and



DUNHAM'S TELLURIAN.

short days. The small figures, A and B, represent removable cones by means of which shadows may be imitated to illustrate eclipses of the sun and moon. By removing the shadow cone from the earth and putting in its place the tide disks C C, as shown in one of the figures, the phenomena of the tides are made easy of comprehension. These disks are made of glass in hemispheres, and are thick in the middle to illustrate high tide and thin at the edges to show low tide—the earth revolving six hours into deep water and then six hours out again, the ebb and flow of the tide being

thus shown twice in twenty-four hours. This improvement has been patented by Mr. William R. Dunham, of Stoneham, Mass.

Weight of Compact Bodies.

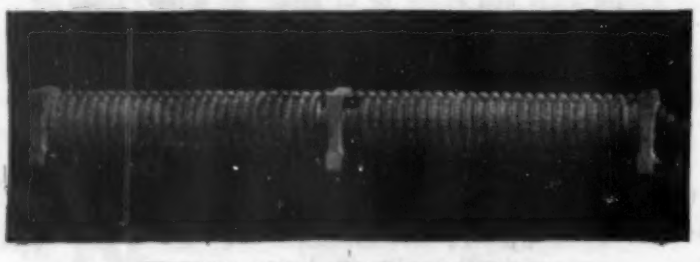
The load which is produced by a dense crowd of persons is generally taken at 80 to 100 pounds per square foot, and is considered to be the greatest uniformly distributed load for which a floor need be proportioned. That this value may be largely exceeded in an actual crowd was pointed out by Professor W. C. Kernot, of Melbourne University, Australia, in a recent paper before the Victorian Institute of Engineers, copied into *Engineering News*. In an actual trial, a class of students averaging 153·5 pounds each in weight were crowded in a lobby containing 18·23 square feet, making an average floor load of 134·7 pounds. There was still room to have placed another man, which would have brought up the loading to 143·1 pounds per square foot. Professor Kernot also quoted from Stoney, who placed 58 Irish laborers, averaging 145 pounds each in weight, in an empty ship deckhouse measuring 57 square feet floor area. This was a load of 147·4 pounds per square foot. In another test, with 73 laborers crowded into a hut, 9 feet by 8 feet 8 inches, Stoney produced a load of 143 pounds per square foot, and estimated that two or three more men could have been squeezed in. It appears from these experiments that while the figures ordinarily assumed of 80 to 100 pounds are sufficiently correct for spaces on which there is no cause to induce the collection of great crowds, larger figures, say 140 or 150 pounds per square foot, should be used for railway stations and platforms, entrances and exits to places of public assemblies or of office buildings, bridge sidewalks, pavements over vaults, and other places where dense crowds are likely to gather.

Stationary Electric Waves.

Before the Berlin Physical Society Professor Raoul Pictet recently gave an account of experiments made by Messrs. Sarasin and De la Rive, by which the rate of the electric waves discovered by Hertz had been measured, and their identity with waves of light in the ether determined. By using large metallic surfaces 16 m. in diameter as reflectors, and by allowing the discharge of the primary spark to take place under oil instead of in the air, it was found possible to obtain stationary electric waves in a long gallery and to determine their nodal points. In the discussion which ensued Professor Kundt stated that Dr. Zenker was the first person who had explained the photographing of colors by means of stationary waves, that stationary light waves were first experimentally determined by Dr. Wiener, and that Seebeck was the first to take photographs of colored objects. After Professor H. W. Vogel, pictures due to the action of light were first taken by a doctor named Schulz, in Halle. In 1727, *Nature* says, this observer treated a solution of nitrate of silver in a small box with calcium chloride and obtained a grayish precipitate. He then covered the box with a lid in which was a hole the shape of some letter, and on subsequently examining the precipitate he saw a dark image of the letter on it. The experiment was found to fail in the dark. Schulz hence concluded that the image of the letter was due to the action of light.

AN ELECTRIC HEATER FOR CARS.

The Consolidated Car Heating Company, of Albany, N. Y., is now producing heaters depending for their effect upon the heating of a conductor by an electric current. The resisting conductor of wire is divided into twelve equal parts, and a multiple switch is provided to throw them in or out of action. Six hundred and twenty-five feet of wire is used in one of their standard sizes. The principal use is for trolley cars, but for house and office use the same company manufactures other heaters, wound for any desired voltage, and for direct and alternating current supply. Our cut shows the neat appearance of the car heater.



INTERIOR C. C. H. CO. ELECTRIC HEATER.

Remarkable Armor Plates.

A test of a new nickel steel armor plate treated by the Harvey process was made Feb. 11 at the Indian Head proving grounds. The object was to determine the tests to be established for the 7,000 tons of armor for which contracts are soon to be let. The test was to include shots at low velocity to show whether the plate would break or crack, and at high velocity to test the resistance to penetration. The plate in this trial was 9 by 7 feet in size and 14 inches thick, and was the thickest plate yet submitted to test. The arrangement of the gun from which the shots were fired and of the backing were the same as in previous tests. The first shot was fired with a charge which gave a velocity at the point of impact of 1,472 feet per second. The projectile entered the plate 5 inches and broke in fragments; no crack could be found in the plate. The second shot, with a velocity at the point of impact of 1,860 feet, entered the plate about 6⅛ inches, and cracked it for a part of its length. The third shot had a velocity of impact of 1,960 feet, and the result was almost the same as with the second. The fourth projectile, with the high velocity of 2,060 feet, entered the plate about 10 inches, cracking it in several directions, and breaking the backing. The tests were considered very satisfactory.

THE TELAUTOGRAPH.

The telautograph, on which Prof. Elisha Gray has been working for several years, has now been so perfected that a public exhibition was recently made of it in New York and in Chicago, at which the representatives of the SCIENTIFIC AMERICAN were present.

Fig. 1.—THE TELAUTOGRAPH TRANSMITTER.

Fig. 2.—THE TELAUTOGRAPH RECEIVER.

Messages were sent over several miles of line. Two instruments, which are small in size and simple of construction, comprise the apparatus. They are the transmitter and the receiver as illustrated. The electrical energy required to operate this device is the same that would be required in a telegraph line of corresponding length, but the most efficient wire is copper instead of iron, and three number 18 wires are used. Two of the wires connect the transmitters with the receivers, while the third is used for such operations as lifting the pen and pencil from the paper, moving the paper along, and the like.

The operator of the telautograph holds the pencil firmly as he would any pencil, and writes naturally, and rapidly if need be, taking care that there be no jerky movements. The instrument has a convenient rest for the hand. The paper is in a roll and is five inches wide, and the operator writes on a plate to a depth of two and one-half to three inches before moving the paper along. Two small silken cords are attached to the pencil and are connected, one to the right, the other to the left, to a small drum inside the case of the instrument. Under this drum, and attached to the same shaft that it is on, is a steel wheel with forty teeth to the inch on its circumference. Every movement of the cords transmits its action to these wheels, and as each tooth of the wheels passes a given point it transmits an electric impulse to the receiver, which reproduces in facsimile whatever line made by the pencil on the transmitter induced the impulse. The receiver is constructed on practically the same principle as the transmitter, but the impulses it receives are transmitted by electrical instead of mechanical means. It has toothed wheels, one at the right and the other at the left, and also a drum inside each wheel. Instead of having cords, both drums have an aluminum arm attached to them. These arms are hollow and ink flows through them, reproducing on another roll of paper whatever mark the pencil has made.

The writing done by the receiver is in fact a series of dashes, but these dashes are so infinitesimal as not to be apparent. Straight lines, curves, in fact any line, can be reproduced, whether it be part of a letter, a flower, or a face. Peculiar characteristics in a person's writing are reproduced to just the marked extent which they are apparent in the original copy. Dotting the I's and crossing the T's are easily done, as by the use of the third wire the pencil and pen are lifted from the paper in the operation. When the operator turns the switch to move the paper along another section, the paper in the receiver is moved automatically the same distance.

This, the latest and one of the most remarkable of Prof. Gray's inventions, bids fair to become a formidable rival of the telephone and the Morse and printing telegraphs.

The Care of Tops and Dashes of Carriages.

When a top carriage comes into the carriage painter's care for repainting, it should be his aim to not only give the leather of the top and dash a good appearance, comparably with a newly finished job, but the refinish upon the leather should be done with the object of preserving it, so that it will retain as good an appearance as the other parts of the carriage as long as possible.

All the so-called "leather dressings" in the market give to the leather a fresh and good appearance for a short time, but they do not wear as long as the finishing varnish used upon the carriage; consequently, a top and dash soon begin to look rusty, and long before the wood and iron work of the carriage needs to be revarnished, they have become so dull and unsightly that the owner of the carriage really has cause to be ashamed of them.

The leather upon carriages seems to have no one who is willing to assume responsibility for its shortcomings. The trimmer repudiates the care of it. The patent nostrum man appears periodically, screaming his dope up to the realms above everything; but practical use shows just what the truck is worth.

The harness maker, the blacksmith, the livery man, and the neighbors, all have a smear to suggest to undo the shabbiness of an old top. The painter is usually asked the leading question, when a carriage comes into his care: "Can you do anything with that top?" And reference is made to the dash in a similar way, and it falls to the painter's lot to do something for the top and dash. He generally buys a "leather dressing," for which he is not responsible in any way, and thus the care of the leather upon a carriage is taken by proxy, as it were, for which no one appears responsible.

All the "top dressings" in the market are only a kind or quality of asphaltum varnish. They give a nice appearance to a top, but they do not keep out water, and they thicken the leather, and, what is equally bad, are not durable.

When a top is old and pretty well gone, leather varnish is as good if not better than anything else for it, because the leather is past being spoiled. For a carriage top on its first reappearance in the paint shop we recommend the following treatment, a method that has been tried on livery buggies, etc., during four years, and has proved itself an excellent one:

The top should be cleaned thoroughly, inside and out, and the rail and joints made ready to be blacked; then take boiled oil and put into it some thinned drop-black, and coat the leather all over with it, brushing it out well. When this has stood half an hour, the places where the top has been folded, and which are more or less cracked, will have absorbed the oil. Go over these spots again; then take some soft rags and rub all the oil and black off so clean that it won't dirty a clean piece of rag.

This treatment thoroughly cleans and polishes the leather, and it fills all the cracks so that they resist water. This oil and black does not dry as hard in a year as the enamel on the leather. It freshens the enamel and gives it a new lease of life. This oil also keeps the straps soft better than neat's-foot oil.

Sometimes a top which has been abused will take in the oil and look dead at the badly folded places the next day or so. These spots should be recoiled and rubbed dry. This does not thicken the leather, and as this oil dries it does not take dirt. Tops that have been done up four years in succession by this method look better than those treated in any other way.

Dashes can be treated with a thin coat of flat drop-black, and rubbed off clean with a rag. This cleans the leather, touches up the scratches, and blackens the seams. When this is dry, give them with the most scrupulous care a flowing coat of wearing body varnish. After four years of this treatment the dashes of common ungrained leather looked almost as good as new. —*The Hub.*

PATENT 492,789, issued March 7, 1893, for a speaking telegraph or telephone, was applied for by T. A. Edison Sept. 5, 1877, nearly sixteen years ago. It has been held back by some concerted action between the Patent Office and Edison until the present time; and if the patent is held to be valid, it will not expire until nearly thirty-three years from the date of application.

Correspondence.

The Maximum Electric Current.

To the Editor of the Scientific American:

In many of our text books on physics and electricity we find stated, but not proved, the fact that the maximum electric current, obtainable from a given number of cells, is got when they are so arranged that the internal resistance of the battery is equal to the external resistance of the circuit.

This is quite a stumbling block to the student who is not familiar with the solution of maxima and minima problems. Nevertheless it admits of an easy algebraic solution, which has been useful to me in the lecture room, and which I therefore send you, hoping that it may interest some of your readers.

The cells of the battery are to be set up in columns and rows, each column containing the same number of cells all united in multiple, and finally all the columns, each of which acts as one large cell, united in series.

The symbols used in the solution are to be interpreted as follows:

C = strength of current in amperes.
e = electro-motive force in volts of a single cell.
r = internal resistance in ohms of a single cell.
R = external resistance in ohms of the circuit.
p = the number of cells in each column.
q = the number of columns.
pq = the total number of cells in the battery.

The strength of current will, therefore, in accordance with Ohm's law, be represented by the following equation:

$$C = \frac{qe}{\frac{qr}{p} + R} \qquad (1)$$

in which qe represents the electro-motive force, and $\frac{qr}{p}$ the internal resistance of the battery.

The problem is now to prove, with p and q both variables, but so related that their product, pq, is constant, that C has its greatest value when $\frac{qr}{p} = R$.

Equation (1) may be written thus:

$$C = \frac{pqe}{qr + pR} \qquad (2)$$

in which, since e and the product pq are both constant, the numerator pqe is constant, however the values of p and q, owing to different arrangements of the cells, may vary. Thus C will have its greatest value when the variables p and q are so related that the denominator $qr + pR$ has its least value. But

$$qr + pR = \sqrt{(qr - pR)^2 + 4\,pqrR} \qquad (3)$$

in which, since r, R, and the product pq are constant, the term $4\,pqrR$ is constant, and the term $(qr - pR)^2$ positive, whether $qr - pR$ be positive or negative. Therefore the radical and its equal $qr + pR$ have their least values and the current C its greatest value when q and p are so related that $qr - pR = 0$.

Or, transposing and dividing by p, when

$$\frac{qr}{p} = R \qquad (4)$$

That is when the internal resistance of the battery is equal to the external resistance of the circuit.

Usually, however, r and R are so related that, with a given number of cells, equation (4) is impossible; but no matter what the number of cells, nor what the relation between r and R, it is evident from equation (2) that C is greatest when $qr + pR$ is least, and from equation (3) that $qr + pR$ is least when $qr - pR$ is most nearly equal to zero; that is, when $\frac{q}{p}r$, the internal resistance of the battery, is most nearly equal to R, the external resistance of the circuit.

We thus arrive at the general conclusion that the maximum electric current obtainable from a given number of cells in a given circuit is got when the cells are so arranged that the internal resistance of the battery is as nearly as possible equal to the external resistance of the circuit.

W. J. HUMPHREYS, *Prof. of Physics.*
The Miller Manual Labor School of Albemarle.

Induction Coil for Alternating Currents.

To the Editor of the Scientific American:

On reading the article "An Induction Coil for Alternating Currents" in the last issue of your paper, March 11, 1893, I was very much surprised to find an accurate description of an instrument in use at the Jefferson Physical Laboratory at Harvard College. The instrument was made by Prof. John Trowbridge about ten years ago, and has been used by him on his class lecture table ever since.

The writer of your article, a Harvard graduate of the class of 1891, is an assistant in chemistry at the Chicago University, and having need of such an instrument as he describes, he attempted to reproduce the one he had seen in the Harvard Laboratory. As his attempt was unsuccessful, he wrote to Prof. Trowbridge, who furnished him with the description and dimensions that appeared in your last issue. The second attempt to reproduce Prof. Trowbridge's piece of apparatus was not wholly successful, on account of the builder's limited knowledge of the induction effects of periodic currents. He again wrote to Prof. Trowbridge, and was furnished with the explanation of these effects and the method of obviating them, as they appear in his article.

The article in your paper was practically made up from Prof. Trowbridge's letters. Prof. Trowbridge, however, informs me that this form of induction coil for alternating currents, with the secondary coil built up about the center of a long primary coil, was first devised and used by Prof. Rowland, of Johns Hopkins University. TOWNSEND H. SOREN.

65 Thayer Hall, Cambridge, March 16, 1893.

The Elliptical Sprocket.

To the Editor of the Scientific American:

Being somewhat interested in your reply to your correspondent on the elliptical sprocket for bicycles, I will give you my experience and will ask you another question. For the past three months I have been using one, and am convinced that there is a gain, and it is quite perceptible in going up grade. Most people have the idea that there is a jerky motion of the pedals when using one of these sprockets. After using one of these a little and then going back to the round, the latter is the one which seems unsteady. In relation to the leg and the body, is this not true? The motion of the leg from the thigh to the knee is an up and down motion, that is from center to center. By the use of an ellipse as applied to the crank axle, is not this motion more steady than a round sprocket would be? Now when using the round sprocket that is the one which seems to me unsteady, and it seems as though there was a back "pull" when nearing the centers. C. L. BARKER.

Pittsfield, Mass., March 6, 1893.

That 212½ Tons of Pig Iron.

To the Editor of the Scientific American:

I am in receipt of George E. Andrews letter of the 7th inst., asking if it is possible for one man to handle 212½ tons of pig iron in ten hours, and I am not at all surprised that the gentleman somewhat doubts it, and I was inclined to throw the article in the waste basket after writing. But I will say that there was no error in the figures, neither have I forgotten. To do what I did a man must pick up and throw onto a pile about 100 pounds every 6 seconds, and pigs of iron will average about 100 pounds each. If the gentleman will take his watch and count 6 seconds, he will see that a sprightly, strong man can do that.

The question would be, Can a man endure that for ten consecutive hours? This I know that I have done once in my life, but will never try the feat again, nor advise any other to try it. I confess that I never was so used up in one day of ten hours. I did not write the article to boast of what I had done, but merely to show what a man can endure. J. E. EMERSON.

Beaver Falls, Pa., March 12, 1893.

Notes from the Columbian Exposition.

Ceylon will make a unique exhibit at the World's Fair. The floor of the building it will erect will consist of Ceylon woods. The pillars, capitals and carvings will all be reproductions of original objects in the ancient cities of Ceylon, and these will all be worked in ironwood, ebony, and satinwood. The gradations of coloring in the carved pillars will be striking. The shading is from pale crimson-yellow of satinwood to the warm orange-brown of the jakwood and the darker tints of margossa, palu and kumbuk. Suriyamara and old root-stem wood of the tamarind are beautiful in the markings. Abundance of light to reveal the beauties of carvings and traceries in the building is to be secured by a large number of windows with beautifully carved frames. One of these window frames will be a reproduction of the stone window from the palace at Yarahu. The building is to cost about $30,000.

The Columbian Rolling Chair Company is now engaging college students for attendance in charge of the chairs. The rates fixed by the Exposition authorities are as follows: For chair carrying one person, 75 cents per hour, 40 cents per half hour; two persons, $1 per hour, 50 cents per half hour; one person, when chair is taken for a period of not less than 10 hours, $6 for the first 10 hours, and 40 cents an hour for the time over 10 hours; carrying two persons, $8 for the first 10 hours and 75 cents an hour after that. In employing men as attendants for the chairs, the company are following the instructions of the Exposition authorities in giving the first chance to college students. The roll will be completed March 1, and 1,600 men will then be employed to report for duty May 1. The attendants will be furnished with comfortable lodgings near the Fair grounds, free of charge, and will be paid 25 per cent of their gross earnings, or will be paid $1 per day and 10 per cent of their gross earnings. The chairs will be mounted on bicycle wheels, with 1½ inch rubber tires and full ball bearings, and will be the only vehicles allowed in the Exhibition buildings.

There is to be a monument of coal at the World's Fair 50 feet high, 10 feet square at the base, and 4 feet square at the top. It is to be exhibited by a Pennsylvania coal company. It will be constructed in sections 16 feet long, and put together at Chicago. Pieces of coal will be selected that will show, when placed in position, all the connecting minerals that are found in the mining of coal. Some parts of the coal will be left in the rough state and others will be highly polished. One single piece of coal already prepared weighs almost two tons.

Apropos of the cost to visitors for seeing the sights of the Exposition, including the entrance charge of 50 cents, a writer in the Chicago *Inter-Ocean* expresses himself as follows: "In the whole length and breadth of the Plaisance are to be about fifty concessions. They include everything, from an electric tower, where a sightseer is asked to pay a dollar for a ride, to the street in Cairo and the Turkish mosque, where the prices are graded from a dime to half a dollar, according to the anxiety of the visitor and the number of sights he sees. Beginning at the east end of the Plaisance, one may pay to walk into the Irish village and see the natives make butter and lace; then he may step over to the electric tower and pay for a ride to the top and back. With his head whirling and his pocket book getting dizzy, he can come to the Bohemian and American glass factories, and pay a quarter for a peep at the blowers. Then he comes to the animal show, and drops half a dollar to see dogs ride tigers and lions draw a cart. If these leave him unsatiated, he can find two panoramas, a Turkish village with dancing girls, a minaret tower filled with curios, a street in Cairo—more dances—a Moorish palace and restaurant, the Algerian section, the Ferris wheel, the ice railway, an old Pompeian house, a Morocco section with balloon attractions, and an Austrian village, and last, a village of Amazons from Dahomey. Each of these has its special features, to which admission is charged by authority of the Exposition. In most cases the fee is 25 cents, in some it is as low as 10 cents, and in others as high as $1. In all cases the Ways and Means Committee derives a revenue of from 20 to 70 per cent of the gross receipts." Finally he arrives at the conclusion that with economy the whole may be seen for $15.

The cars for the intramural elevated railroad at the World's Fair grounds will be 45 feet 11¼ inches long over the platforms, 8 feet 6 inches wide, and have a seating capacity of 70. The seats are fixed back to back and extend entirely across the cars, as in the ordinary open street cars. The sides of the car are closed for a height of about 3½ feet, or to the tops of the backs of the seats, and are provided with sliding doors or gates for ingress and egress. Above this the sides are open, but are fitted with drop curtains to protect the passengers from the sun or rain. The running gear is almost a duplicate of the Manhattan and Chicago elevated trucks. The cars are equipped with the New York Air Brake Company's special brake for high speeds, and the first train of cars having been completed, tests of the apparatus will be made in Chicago in a few days. The motive power of the road is to be electricity. The motor car carries passengers and in many respects is a duplicate of the others. In addition to the motors for hauling the train, it has an air pump operated by an electric motor. The brakeman stationed on the end platform of the car controls the hand brakes, the roller curtains and the gates. The cars weigh about 2,200 pounds and are lighted by electricity.

Leaky Roofs at Chicago.

Director-General Davis has issued an order to release no more exhibits from bond at present. Cars loaded with goods from foreign countries were stopped on the tracks at the entrances to several buildings. Customs inspectors were cautioned not to allow the seals to be broken and to hold the cars until further notice.

This order was the result of protesting against the leaky roofs of Manufactures, Agricultural, and Transportation halls by the foreign commissioners, many of whom had commenced to unpack their displays. They told Colonel Davis that their exhibits would be ruined if exposed to the rain that ran in torrents through the roofs, and demanded that the leaks be stopped at once, that they might go on with the arrangement of the displays.

The roof of Manufactures Hall is in a very bad condition. The construction department has not been able to make repairs since the snow slide crushed the skylights, and water rushes through in cascades. With the exception of several sections the floor was completely drenched lately. In some places water stood in pools an inch deep. The exhibitors of half a dozen foreign nations and many Americans were compelled to quit work.

THE order has been given that all the portraits taken in her Majesty's prisons, as records of crimes and criminals, shall for the future be printed only on platinum paper, the object being to secure their permanency.

FACTORY DRIVING BY ELECTRICITY.

Although the transmission of power by electricity is considered by many engineers to be principally applicable to cases in which energy is to be carried for long distances, yet we are of opinion that, says the London *Engineer*, the day is not far distant in which electricity will become a powerful rival to the systems of belt, wire-rope, and cotton-rope transmission. The great losses which are unavoidably present in the last named systems are so important that it must be of interest to take note of any considerable application of electricity, either here or abroad, which tends to diminish them. The following, concerning the new small arms factory at Herstal, in Belgium, puts the matter very clearly before us. The area covered by the establishment is about 19·8 acres in extent.

The shafting may be conveniently divided into main and counter shafts, and if, for example, there would be 10 per cent loss upon each subdivision of energy, the total loss would be 30 per cent. In all systems of rope or belt driving a single accident may stop the whole establishment, and there is an excessive dead weight to be turned. The counter shafts and pulleys themselves weigh 110 tons, and the rest, without reckoning belts, at least 88 tons. Another great objection to ordinary mechanical transmission is the impossibility of extension. When shafts are put up for 300 horse power, all must be replaced if 450 horse power is to be transmitted. It is obviously best to transmit a large part of the power to distant points, and for this purpose ropes are very cumbersome and inefficient. Besides the pulleys and shafting, about 30 tons of hangers, plummer blocks, etc., must be put up. The idea was therefore accepted that the whole works should be driven by electricity. It was decided to place one dynamo of 500 horse power upon the engine shaft. The engine had already been ordered, and was to run at sixty-six revolutions per minute. A new type of dynamo had therefore to be designed, and the fly wheel was done away with, and the plummer blocks moved further apart. Even if two dynamos of 250 horse power each were used, it would be no advantage, as the work must go on throughout the establishment regularly. The Société Internationale d'Electricité undertook the work in order to compare the efficiency of electrical transmission with other kinds; the most eminent firms were asked for details as to the power necessary at the engine to deliver a given power to the machines, but not one would give a guarantee as to the efficiency of a mechanical method of transmission. There are in all—

9 shafts requiring 12 horse power each = 108
2 shafts requiring 16 horse power each = 32
2 shafts requiring 30 horse power each = 60

Total, 200 horse power.

For these the following motors were put in, to be well above requirements:

9 motors of 16 horse power = 144
2 motors of 21 horse power = 42
2 motors of 37 horse power = 74

Total, 260 horse power.

Of these the guaranteed efficiencies were 16 horse power—87 per cent; 21 horse power—87 per cent; 37 horse power—89 per cent; making 296·9 horse power required; 2 per cent loss in leads, 5·93; total, 303 horse power.

The efficiency of the generating dynamo is 90 per cent, so that the efficiency of the transmission between the brake horse power of the engine and the shafts of the motors is 77·2 per cent. The efficiency of the engine was guaranteed to be 92 per cent, but tests have shown it to be 94 per cent, so that the power delivered by the motors is 72·5 per cent of the indicated horse power of the engine. If we allow another 4 per cent between the motor shaft and the actual counter shafts of the tools, we obtain 69·5 per cent. The use of one dynamo has been criticised, but two dynamos of 250 horse power each could not well have been built to run at sixty-six revolutions only; and if they could, the cost would be £1,200 in excess of that of one large machine. There are, however, two commutators, and these enable the dynamo to run at half load. A noteworthy fact is that, owing to the absence of all belt transmission, the power necessary to drive the engine idle is only 28 horse power instead of 40 horse power. A great advantage in the shops is that the shafts need not be parallel to one another.

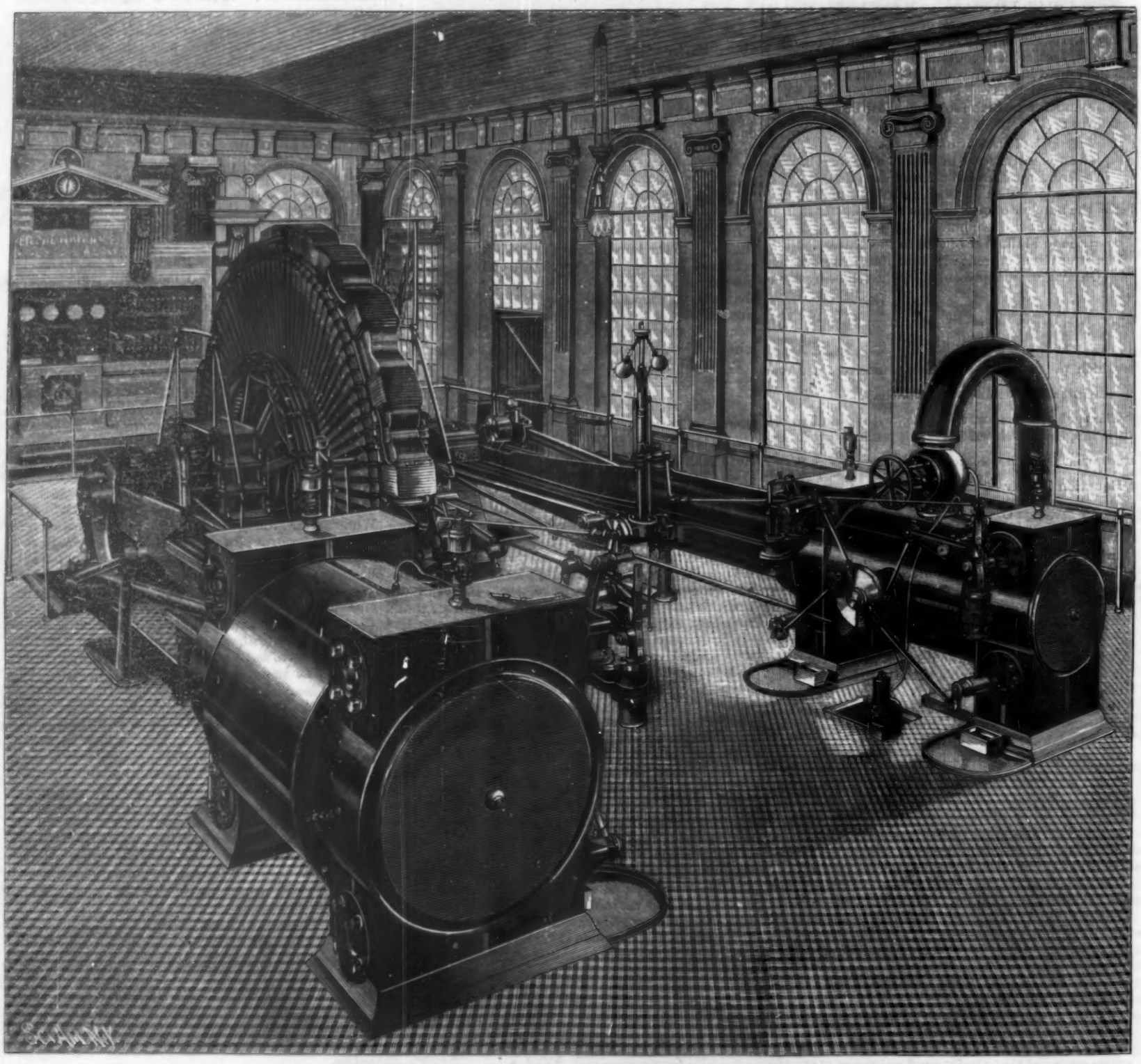


Fig. 1.—COMPOUND CORLISS DYNAMO ENGINE, AT HERSTAL, BELGIUM.

Passing now to the electric machinery itself, we may say that the contractors guaranteed an efficiency of 70 per cent for the whole transmission, knowing well, however, that it would be exceeded. The cables are short, and the total weight of copper in them is 5·14 tons, so that the loss is only 2 per cent. The motors vary in size from 3 horse power to 37 horse power, and are of the usual type. The main dynamo was, however, the object of careful study, as no machine, we believe, has previously been built to run at such slow speeds. The Gramme winding was the only type suitable, and the magnet cores had to be made of mild steel, as the price of wrought iron was prohibitive, and the cast iron would not give good enough results.

Our illustration, Fig. 2, represents the dynamo and part of the engine.

The field magnets are shunt wound, and arranged

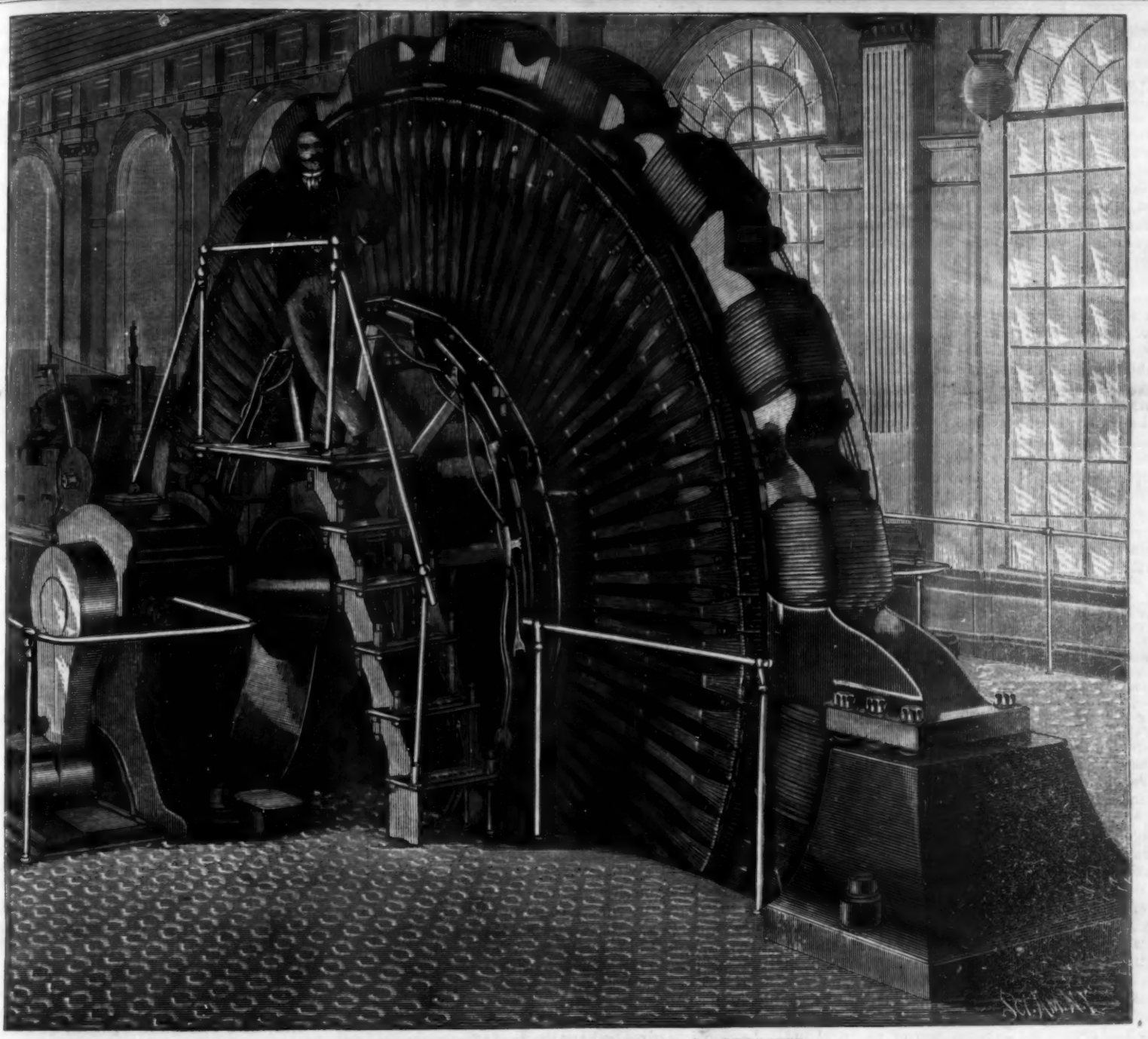


Fig. 2.—THE GREAT DYNAMO, HERSTAL, BELGIUM.

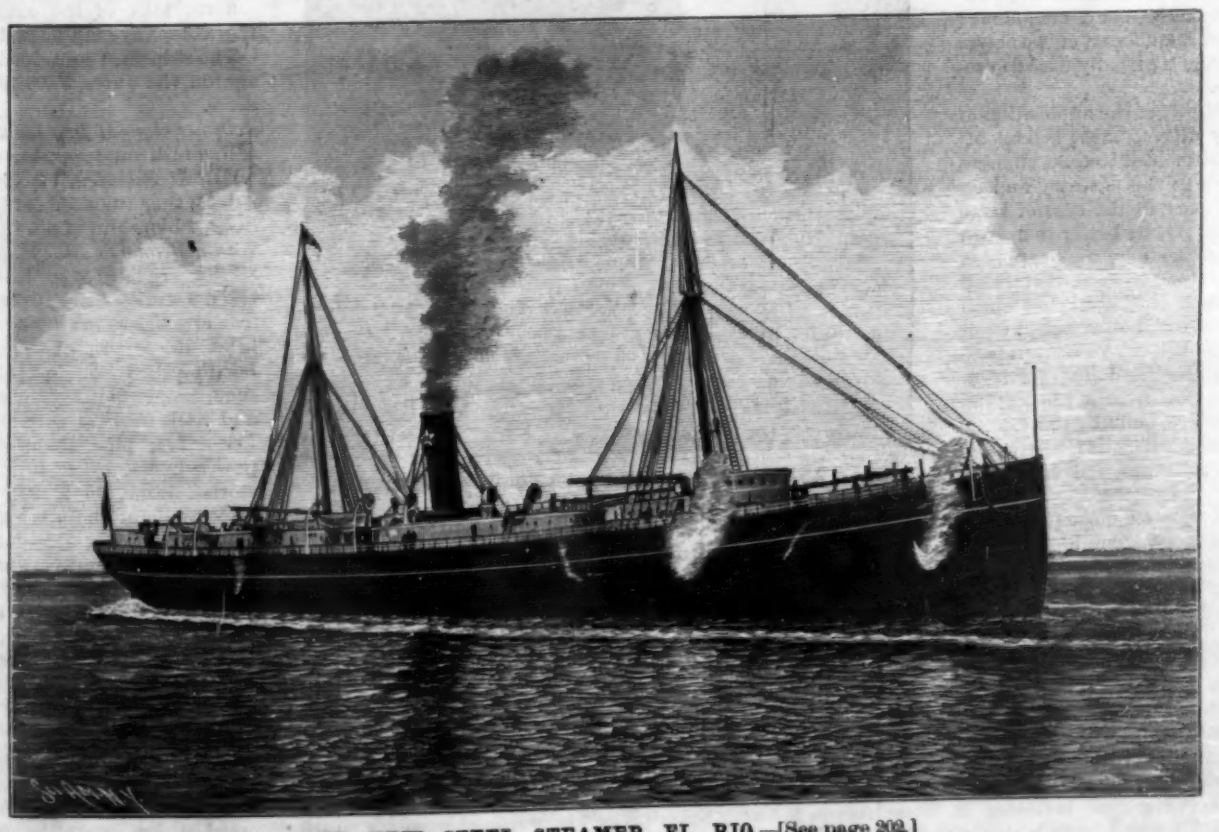
in a ring consisting of ten pieces bolted together and having twenty pole pieces. The air space is 0·245 inch wide. The magnets were fixed in position, then dismounted to allow the armature to be wound; this had to be done in position, owing to the size of the machine; the ring was then finally erected. The armature was constructed as follows: First a boss was forced upon the shaft by hydraulic pressure, and a hollow saucer-shaped casting was bolted to each side to take the place of the arms of an ordinary fly wheel. The circumference of the castings is formed into a hundred teeth, and these grip the core of the armature, which is 15·8 feet diameter, and formed of iron plates 0·275 inch thick; these are placed side by side and make a total width of 15·8 inches; the radial length of the plates is 5·1 inch. This mass of iron forms the rim of the fly wheel, and possesses ample weight to insure regular motion. Through fifty of the teeth bolts are passed to hold the core plates together, while the other fifty support cross bars upon which the plates rest; all are carefully insulated from the plates, and the latter are covered with paper.

The winding consists of flat wire 0·158 inch by 0·196 inch, insulated with cotton and shellac. Only one layer is wound outside, but there are two layers inside, as the wires have to pass between the teeth of the side castings. The whole armature has 2,400 of these windings, and carries two commutators, to which alternate windings are attached.

All the wires were bent to template, and are very easily dismounted and replaced. The top of one winding and bottom of the next on the same side of the armature are soldered to a copper plate, which conducts the current to a bar of the commutator, one bar corresponding to each winding. The commutators are 8·2 feet in diameter. Binding wires of phosphor-bronze, 0·059 inch in diameter, are used for holding the winding in position. Eighty brushes collect the current, and these are lifted and lowered simultaneously by special apparatus, and the lead can be easily regulated.

This machine can develop 2,400 amperes at 125 volts, and four cables lead the current to the switch board. The efficiency, as previously stated, is 90 per cent, and the density of the current is 1,940 amperes per square inch in the armature winding and 1,000 amperes in the magnet windings.

The boss of the



THE NEW STEEL STEAMER EL RIO.—[See page 202.]

armature weighs ten tons, the armature core six tons, the side castings eight tons, the copper in the magnets two tons, and in the armature 1,320 pounds. If a short circuit should occur in the works, the armature will be subjected to an action like that of a brake, but it will not have the bad effect which would be produced if the armature did not itself constitute the fly wheel. There are, as will be observed, only two bearings, one on each side of the machine. The two sets of cables are connected in parallel at the switch board, where the requisite instruments are fitted up, so that the pressure in either half of the machine or in the shops can be noted, and suitable cut-outs are fixed.

Lighting is effected by 116 arc lamps, two in series, using 10 amperes, and by 200 16 candle power incandescent lamps. The current for the latter is taken from a ring main supplied by 24 feeders, and the total loss of pressure is 7 volts when all the lamps are lighted at once. The ring and feeders are of bare wire, except in cable tunnel. All the motors are of the Gramme type, with two windings. The base plate and the top yokes are attached together in casting to allow of boring the interior easily, and the magnet cores are cylinders of wrought iron shunt-wound. Carbon brushes are used on the motors, and have so far given no trouble. The electrician would not be able to occupy his time were it not that he has also to attend to the arc lamps and replace their carbons.

The following is a list of the motors used throughout the works, or rather the list of those which were ordered at first:

Situation.	Horse power.	No. of motors.	Guaranteed efficiency.
Main shop	16	9	87 per cent.
Wood-working department.	21	1	87 "
Forge	37	3	89 "
Stamping and drawing shop.	16	1	87 "
" " "	7	1	84 "
Feed pump	10	1	85 "
Fans	3	1	80 "

The average efficiency can, of course, be obtained by multiplying the number of motors by their respective efficiencies. Taking this sum and dividing by the total number of motors, this gives 87·2 per cent.

Eventually the 7 horse power motor was countermanded, and a 16 horse power motor put down for the polishing shop and one of 21 horse power for the cartridge shop. On some of these motors the load is very variable, and several are exposed to dust and dirt, so that with 90 per cent efficiency of the dynamos, 98 per cent of the conductors, 87 per cent of the motors, the net result is 76·6 per cent power delivered. As the lost work in belt driving is practically a constant quantity for all loads, or at least is usually, considered to be, the power required to turn the shafting, pulleys, etc., at the normal speed when no work is being done on the machines, it follows that taking 79·4 per cent as the final output in two cases, one of electrical and the other of mechanical transmission, we find that at a load of 20 per cent the electrical system would still give 47·2 per cent useful effect and the mechanical nothing at all. From careful experiments which have been made in actual practice, it has been clearly proved that to drive all the machines idle needs more power than to drive the shops in the ordinary course of work; whereas 11 electrical horse power is required when driving all the tools idle, only about 7 electrical horse power is needed in ordinary work, of which 4 electrical horse power is used to drive the shafts, belts, etc., alone; this clearly shows how small a part of the power produced by the engine is actually used in useful work at the tools.

Such satisfactory results of the application of electricity to factory driving must attract attention and will doubtless lead to great changes in transmission, both in this country and on the Continent. Whether in the case of large machine tools it would not be better to discard shafting and belts altogether, and supply a special motor to each tool, is a question which must be settled for each individual case which may arise; the current could be switched on or off just as easily as the belt is now thrown from the loose to the fast pulley, and *vice versa*.

We give an engraving from a photograph of the engine, which was built by the Société Anonyme des Anciens Ateliers de Construction Van den Kerchove, of Ghent, and erected by them.

It is designed to develop 450 horse power, but gives without difficulty 530. The high pressure cylinder is 19 inches in diameter, the low pressure 32 inches and the stroke 5 feet. The number of revolutions is 66 per minute, with a pressure of 90 pounds. The dynamo, as will be seen, is placed between the high and low pressure engines, the armature being sufficiently heavy to dispense with a fly wheel.

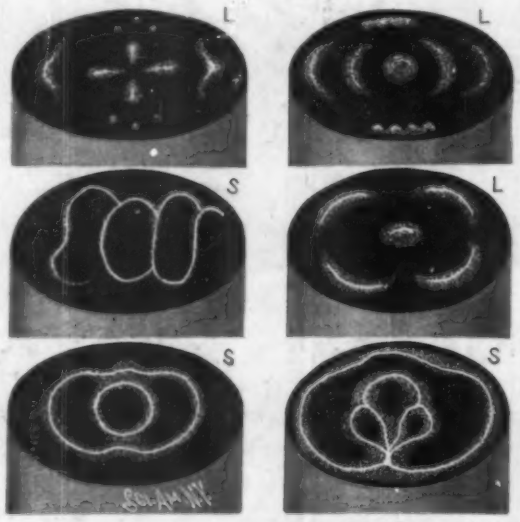
The Compagnie Internationale d'Electricité, of Liege, have put in the electric plant with complete success. The regularity in running of the engine is all that can be desired, the governor keeping it under perfect control. Running light the engine indicates 28 horse power and loaded 530 horse power, which gives an efficiency of 94·7 per cent. The consumption is about 13·25 pounds of water per horse power per hour. We are indebted to the *Engineer* for our illustrations and the foregoing particulars.

DUST AND SAND FIGURES ON MEMBRANES.

T. O'CONOR SLOANE, PH.D.

Some attention has recently been excited by what are known as dust figures produced on the surfaces of vibrating membranes. They are virtually Chladni figures, and the membrane on which they are produced can be made to give good results with sand and lycopodium. Of course, the outlining of loops and nodes on vibrating membranes is old, but by substituting for the violin bow usually employed a more active system of obtaining vibrations, very curious and interesting results have been obtained.

In the cut we illustrate an exceedingly simple apparatus for this purpose. Over the top of a cylindrical box a sheet of very thin India rubber is stretched, and



APPARATUS FOR PRODUCING LOOPS AND NODES ON A MEMBRANE.

held in place by a rubber band. Around the edge is a band of paper, projecting about half an inch above the surface of the rubber so as to form a species of fence or wall. A hole in the side of the box admits a tube. If, now, a note is sung into the tube, the India rubber is thrown into vibration with a production of loops and nodes whose position varies with the note produced. An endless variety of figures can thus be formed.

Lycopodium gives perhaps the most effective results. When the experimenter sings strongly into the tube, if the lycopodium has been scattered over the sheet, it begins to gather itself into most peculiar shapes; sometimes little circular heaps of it form which are maintained in perpetual agitation, the loops and nodes producing the most varied outlines. In the smaller

DUST AND SAND FIGURES PRODUCED ON A VIBRATING MEMBRANE.

cuts, the three diagrams marked L represent lycopodium diagrams.

A great point in producing the figures is to cease the note suddenly and without changing its pitch. One is very apt with cessation of sound to change the pitch and produce confusion. If, while the lycopodium is on the sheet rubber, the intensity of the sound is increased, some of the lycopodium is thrown in the air, and if the sound is made strong enough, a perfect cloud of the dust is maintained, sharply localized over the points of agitation, representing the Chladni figures in a very beautiful and interesting manner.

With sand, three of whose figures are shown in the small cuts under the letter S, the results produced are less impressive, perhaps. At any rate, in precision of outline they do not, as a rule, compare with those given by brass or glass Chladni plates. Like the lycopodium figures, they give results which surpass those of solid plates in complexity and in the prevalence of curved outlines. The usual types of Chladni figures can hardly be obtained.

For the box, any tin or pasteboard box can be used. The rubber should be very light, and for even figures should be evenly stretched, but by stretching it with different tension in different directions the figures can be considerably modified. The appliances are all so simple that the experiment can be recommended as really a very interesting one.

One experimenter is said to have produced fixed relief maps of the curves by the use of plaster of Paris. In such cases the note must be uniform and must be maintained until the plaster sets hard.

In old violins dust balls are sometimes found. The experiments described give the clew to their formation. The vibrating wood of the violin acts to gather the dust into balls. The same action can be seen in the lycopodium on the vibrating membrane.

THE NEW STEEL STEAMER EL RIO.

This new American steamer, built of steel by the Newport News Ship Building and Dry Dock Company, recently made her trial trip in this harbor, when she attained a speed of 17 knots per hour. The vessel has taken her place on the line between New York and New Orleans.

El Rio is a freight vessel of 4,500 tons register and of the following general dimensions:

Length between stem and after side of propeller post, 380 feet; breadth of beam moulded, 48; depth from top of keel to top of upper deck beams of lowest part of sheer, 33·9; length over all, 406.

She has three decks and a partial orlop deck at fore-end of forehold. On the awning deck are steel houses. She is rigged with two steel pole masts and the necessary booms for handling cargo, together with steam hoisting engines located at the different hatches, to work in connection with them. Freight hatches and ports are located so as to handle cargo expeditiously.

The vessel is steered by steam from the forward pilot house or by screw hand gear from the after house.

A steam windlass and steam capstans are provided for handling anchors, hawsers, etc., as well as a steel rope with drum aft for towing.

She is propelled by a vertical triple expansion engine with three cranks, placed at angles of 120°. The cylinders are 32, 52, and 84 inches diameter by 54 inches stroke of piston, working under 167 lb. of steam, which is generated in three double-ended cylindrical steam boilers with three corrugated furnaces at each end. There are two fire rooms and one smokestack.

The vessel is lighted throughout by electricity.

The Newport News Ship Building and Dry Dock Company, at Newport News, Va., is one of the largest and most fully equipped ship building establishments. Several fine vessels of steel have already been constructed, and others are in progress. Among them are El Sud and El Norte, two splendid steamers, each of about 4,500 tons. Another, El Cid, is on the ways, same dimensions as El Rio.

Some idea of the extent of the works of this company may be had from the following:

The ship yard contains 75 acres of land; frontage on the water, 2,600 feet; buildings cover 7 acres.

Dimensions of Dry Dock.—Length on top, 600 feet; width on top, 130; width on bottom, 50; width at entrance, 93; draught of water over sill, 25; time required for pumping water out of dock, 1 hour and 30 minutes.

Dimensions of Buildings.—Office building, 3 stories, brick, 40 × 200 feet; pattern and joiner shop, 3 stories, brick, 60 × 300; machine shop, iron and brick, 100 × 300; boiler shop, iron and brick, 100 × 300; blacksmith shop, 100 × 300; bending shed, iron and brick, 60 × 127; framing shed, frame, 344 × 270; ship fitters' shop, iron and brick, 60 × 320; ship blacksmith shop frame, 120 × 208; pipe fitters' shop, frame, 50 × 208; power house, brick, 40 × 130; lumber shed, 2 stories, frame, 40 × 300; pump house, brick, 43 × 60; paint shop, brick, 50 × 160; fitting-up shop, brick, 50 × 175; stable, 2 stories, brick, 40 × 60; timekeeper's house, frame, 50 × 40.

Piers.—No. 1, 60 × 900 feet; No. 2, 60 × 350; No. 3, 80 × 350; No. 4, 60 × 550; outfitting basin, 900 × 500.

Ship Ways.—Nos. 1 and 2, each 400 feet long; Nos. 3 and 4, each 450; Nos. 5, 6, 7, and 8, each 650.

The various shops are fitted with machinery of the latest pattern, and are capable of handling the largest work known in ship building.

The machine and boiler shops are supplied with power traveling cranes of 50 tons capacity, and the appliances throughout the yard for handling material are of novel design, enabling work to be done with dispatch and in an economical manner.

RECENTLY PATENTED INVENTIONS.

Railway Appliances.

CABLE GRIP.—James S. Patten, Baltimore, Md. This is a gripper of simple construction and easy to manipulate, which is adapted to grip the cable by lateral pressure and drop it vertically when released, while the grip can be quickly adjusted to again pick up the cable without the aid of lifting levers or other additional means. When a cross cable is reached, the grip automatically lets go its cable, rides over the other cable, and drops into position to again pick up its cable on the application of the gripman's lever. The clamp jaws are incapable of slipping or loosening their hold on the cable after they are applied, thus saving frictional wear.

ELEVATED CABLE RAILROAD.—William R. Heylmun, Rich Hill, Mo. According to this invention, the cars are suspended below the rails, which form a duct for the cable propelling the cars. A novel means of switching onto side tracks is provided, with means for actuating the grip to engage or release the cable. This road can be set up at a moderate cost on sea beaches, etc., and is more especially designed for pleasure trips, but can be readily arranged to carry freight.

Mechanical.

MORTISING MACHINE.—Simeon J. Hicks, Englewood, Ill. This is a machine especially adapted to make mortises in the stiles of doors, although useful for other purposes. It has a longitudinally reciprocating carriage carrying work-holding clamps, a transverse reciprocating frame with chisels moving above the carriage, and a clutch-controlled driving mechanism reciprocating the frame and carriage. The machine is designed to perform its work very nicely and rapidly, the mortising chisels operating from both sides of the work, while the article to be mortised may be quickly placed and removed.

SUPPORTING JOURNAL BOXES.—J. Friedrich Hey, Strasburg, Germany. The bracket or hanger is provided with a disk having a circular recess, while the bearing support is provided with an eccentric disk or flange having an offset projecting into the recess of the disk of the bracket. A ring clamp secured to the bracket engages the front face of the eccentric flange or disk. The device is simple and durable, and permits of a wide range of adjustment.

Agricultural.

PLOW.—Agustin M. Chavez, Mexico, Mex. This is an improvement in plows whose beams are attached at their front ends to a truck or wheeled frame. A stirrup is adapted to be attached to the straight section of the plow beam, and by sliding this stirrup toward the rear curved portion of the beam, the plowshare may be made to enter the ground more or less deeply, the nearer the stirrup is carried to the share the deeper being the furrow. In connection with the plow a sod cutter is employed, clipped upon the plow beam in such a manner that the turner will be adjustable.

STOCK WATERING DEVICE.—Anson Carey, Ashland, Neb. This is a device for watering hogs and other stock, and consists of a trough with a water supply pipe in its rear, a gravity lid or nose gate hinged in its rear being adapted to close down on the trough, and having an upwardly and outwardly inclined lip at its forward end arranged, when the lid is down, to leave the top of the trough open in front. A stopper to the supply pipe is pivotally connected with the hinged nose gate for operation by the latter in both directions. According as the nose gate is raised is the flow of water to the trough, and the animal always has a fresh supply of water, but none is wasted, the flow stopping when the nose gate closes itself.

Miscellaneous.

WIND WHEEL.—Benjamin J. Sykes, Sykesville, Pa. This invention relates particularly to improved connections between the power shaft and plunger rod, facilitating the utilizing of the power of two wheels simultaneously, and equalizing any difference of speed between the wheels, preventing jerking or binding upon one side of the plunger rod. The construction is such that the entire machine is designed to be perfectly balanced, thus having great strength and durability. In operation, one of the wheels is turned to face the wind, and the back of the other wheel corresponds with the face of the one in the wind, the wheels revolving simultaneously in opposite directions.

VEHICLE SEAT.—Jacob Ruch, Mount Eaton, O. This invention provides improved connections between the seat and the vehicle body. The seat has a hinged back, and a crank rod mounted on the under side of the seat has arms pivoted to its cranks and secured to the seat back, a lever being secured to the crank rod and a fastening device to fix the position of the lever. The seat is especially adapted for two-wheeled vehicles, the position of the seat back being readily shifted to make the seat easy, and also for its adjustment to bring the weight of the load in the right position in relation to the wheels, thus enabling the vehicle to be properly balanced, so that it will ride and draw easily.

DISINTEGRATING BITUMINOUS ROCK.—Ben Hager, Salt Lake City, Utah Ter. This is an apparatus especially designed for disintegrating rock or dry asphaltum, and the kettles in which the material is placed have each a stationary grate, between the bars of which oscillating bars are made to swing, a steam pipe delivering steam beneath the grate while another pipe delivers steam above the grate. As the steam disintegrates the asphaltum the oscillating bars force it down to the bottom of the kettle, from which it may be drawn out as desired, the operation being preferably carried on in two connected kettles, so that the work is continuous.

POST HOLE DIGGER.—John Tipton, Hymera, Ind. This device has a cylindrical body of iron or steel, with its lower edge notched and beveled to form cutters, and within the cylinder is an adjustable or sliding disk having a central opening, the disk being rigidly attached to a rod, which extends upward, and ends in a ring surrounding the handle. When the digger is forced into the ground, the dirt is tamped inside the cylinder by the operator pressing with his foot upon the ring, thus forcing the disk down upon the dirt, and enabling the latter to be lifted with the digger out of the hole.

FLOOR CLAMP.—Mathias Lutgen, West Bend, Ia. This device has a base plate carrying a lever, and means for fulcruming the body of the implement on a joist, a rocking dog being movable with the plate in response to the throw of the lever, the latter serving to rock the complete implement on its fulcrum. The device greatly facilitates the clamping and pressing up of the boards of a floor while it is being laid, to close the joints between the boards, and provide for nailing the boards while so closed and held one against the other.

FENCE.—William P. Sharp, Lowell, Kas. This is a fence designed to be conveniently set up and taken down, and is well adapted for use upon even as well as upon uneven ground. It consists principally of supports and panels, the supports being formed of two posts crossing each other near the upper end and connected at about the middle by a cross bar. The panels have at each end a post or batten, to which are secured longitudinal rails adapted to engage the supports, the adjacent panel posts being connected with each other at their upper ends by a link.

SUPPORT FOR BRACKET TABLES.—John N. Tiffany, San Diego, Cal. A novel, convenient, and substantial support is provided by this invention for a small table top that may be adjustably attached to a chair or bedstead for the use of an occupant, affording means for holding an open book at any desired angle before a reader, and projecting the book support over the bed or the chair, as may be desired. The table top is also available to hold writing materials and to write upon. When not in use the support may be packed together in compact form.

SASH FASTENER.—Emanuel and Henry S. Ensminger, Bloomington, Ill. This is a cheap lock, quickly applied to any window, so that it cannot be accidentally unlocked by the rattling of the sashes. The invention is an improvement upon a former patented invention of the same inventors. The latch is pivoted on the top of the lower sash, and a spring concealed in a transverse recess in the under side of the latch engages a stud to press the latch normally inward to lock the sashes. The sashes may be held at any desired height, or the lower sash may be raised and held as desired without moving the upper sash.

FOLDING TABLE.—John C. and Hiram A. Carl, Allentown, Pa. This invention provides an extremely cheap and simple table to which any kind of a table top may be applied, which may be extended when desired to form a long table or an ironing table, or be folded into small compass to make a neat and compact stand. The table, whether extended or folded, is very strong, and the invention covers various novel features of construction and combinations of parts.

HAND STAMP.—Samuel A. Harrison, New York City. This is a registering or counting stamp, which will positively count every impression and display the amount so that it may be easily read. Its construction is simple, and such that it is not likely to get out of repair, and it may be conveniently reset whenever necessary or desirable. The dial is in a glass-covered case in the top of the handle, and the hands are moved every time the stamp is pushed down to make an impression.

LAP RING.—George Bobb, Yokena, Miss. According to this invention the two members of the ring are connected by a loose universal or swivel joint, which adapts it to be easily and quickly applied to or detached from single and double trees, chain links, etc. The ring thus made is very strong and durable, since the joint between the two hooks is not formed by aid of a pin, rivet, or pintle, as usual in such devices, but by circular eyes, which are integral portions of the hooks.

Designs.

HEAD FOR FUR COLLARS.—Bernard Cohen, New York City. This design represents an animal's head, to be used as an ornament, a rib-like figure being produced in relief upon the muzzle and extending around the edge of the mouth, and the curved tongue lying upon the under jaw.

RUG FASTENER.—George B. Shellhorn, Montgomery, Ala. This fastener is a triangular-shaped body, having concave edges and tapering extensions projecting at right angles from the body, one of the extensions projecting oppositely to the other two.

HEEL OR SOLE PLATE.—George J. Davison, Richmond, Va. The leading feature of this design consists in the shape and ornamentation of the completed article, of segmental shape, and with V-shaped openings with prong-like projections.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

AIDE-MEMOIRE PRATIQUE DE PHOTOGRAPHIE. Par Albert Londe. Paris: J. B. Bailliere et Fils. Pp. 337.

THE DAILY NEWS ALMANAC AND POLITICAL REGISTER FOR 1893. Compiled by George E. Plumbe. Ninth year. Issued by the Chicago Daily News Company. Pp. 424. Price 25 cents.

From the Chicago *Daily News* we have received its almanac. It is a work containing in excellent shape the exhaustive data now found in the different newspaper almanacs.

TIPS TO INVENTORS. Telling what inventions are needed, and how to perfect and develop new ideas in any lines. By Robert Grimshaw. New York: The Practical Publishing Company. 1893. Pp. 84. Price $1.

Dr. Grimshaw is well known as a very bright and graphic writer. In these hints to inventors he makes a number of suggestions of what people might invent, and many of them seem exceedingly well put. Exactly what he means by the following "tip," however, is not very clear: "The chemist who will make from cotton seed either a drying or a non-drying oil should not want for cash if he manages his affairs properly" (pp. 21, 22). Exactly how this is to be considered a tip to inventors is not clear. The advice on perfecting and developing patents and on selling patents makes very good reading.

MARKET GARDENING AND FARM NOTES. Experiences and observations in the garden and field, of interest to the amateur gardener, trucker and farmer. By Burnet Landreth. New York: Orange Judd Company. 1893. Pp. iv, 215. Price $1.

The subject of truck farming farming in this work seems treated thoroughly up to date. The author is not restricted in his knowledge to American gardening operations, but he is able to contrast American processes and customs with those of other lands. This gives the work an international character which makes it really attractive reading. We believe that it should be in the hands of every enterprising cultivator of vegetables.

HOW TO MANAGE THE DYNAMO. A handbook for ship engineers, electric light engineers, and electro-platers. By S. R. Bottone. New York: Macmillan & Co. 1893. Pp. 63. Price 60 cents.

This very short treatise is designed as a handbook for ship engineers, electric light engineers, and electric platers. It is elementary, therefore, and quite practical in its treatment. Of its 63 pages, 17 are devoted to definitions, so that altogether the amount of matter given is not very large. It has no table of contents, but has an index adequate for its size.

THE "PRACTICAL ENGINEER" POCKET BOOK AND DIARY. 1893. Edited by W. H. Fowley. All rights reserved. Second edition. Technical Publishing Company, Limited, London. John Heywood, Manchester. Price 60 cents.

In addition to very numerous horse power tables, notes on heat, waste of materials, and the usual data given in works of this character, a memorandum diary is found, making the work a useful compact companion for the civil or mechanical engineer.

☞ Any of the above books may be purchased through this office. Send for new book catalogue just published. MUNN & Co., 361 Broadway, New York.

SCIENTIFIC AMERICAN BUILDING EDITION.

MARCH, 1893, NUMBER.—(No. 89.)

TABLE OF CONTENTS.

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2. Plate in colors showing the residence of the Hon. John J. Phelan, at Bridgeport, Conn. Two perspective views and floor plans. Mr. A. H. Beers, architect, Bridgeport, Conn. An excellent design. Cost $6,000 complete.
3. A dwelling at Springfield, Mass., erected at a cost of $4,000 complete. Perspective views and floor plans. Messrs. Granger & Morse, architects, Springfield, Mass. A model design.
4. A cottage erected near Brighton, Mass., at a cost of $2,800. Floor plans, perspective view, etc. A. W. Pease, architect.
5. Engravings and floor plans of a residence at Greenwich, Conn. A beautiful design in the Colonial style of architecture. Mr. W. S. Knowles, architect, New York.
6. A dwelling recently erected at Brookline Hills, Mass., at a cost of $5,300 complete. A picturesque design. Perspective elevation and floor plans. Messrs. Shepley, Rutan & Coolidge, architects, Boston.
7. Sketch of a tasteful design for a three-family cottage, to cost about $4,500.
8. Plans and elvations of an English cottage of quaint and pleasing design.
9. View of the Fifth Avenue Theater, New York. A splendid example of modern architecture in the style of the Italian Renaissance. Together with a portrait and biographical sketch of Francis H. Kimball, architect, New York City.
10. Miscellaneous contents: Paving estimates.—World's Fair items.—Painting the World's Fair buildings.—Drawing instruments for colleges, etc., illustrated.—A tasteful fireplace design, illustrated.—An improved steel spring hinge, illustrated.—Vegetable growth in water mains.—American machinery in London.—A foot radiator valve for hot water radiators, illustrated.—New tin plate plant.—An improved furnace, illustrated.—Cincinnati woodworking machinery.—An improved door hanger, illustrated.—A big heater company.

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For Sale—Patent on improved mine car. See illustrated notice on page 180. For terms and particulars address Homer Durand, Starkville, Col.

To Let—A suite of desirable offices, adjacent to the Scientific American offices, to let at moderate terms. Apply to Munn & Co., 361 Broadway, New York.

Hydrocarbon Burner (Meyer's patent) for burning crude petroleum under low pressure. See adv. page 381. Standard Oil Fuel Burner Co., Fort Plain, N. Y.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(4787) G. W. V. asks how to make a Lalande oxide of copper battery in the cheapest way possible. I heard that they could be made of tin tomato cans. A. See SUPPLEMENT 792.

(4788) F. T. G. asks: If one heat unit raises the temperature of one pound of water one degree, how many heat units will be required to raise the temperature of one cubic foot of air one degree? A. One heat unit will raise one pound of air one degree. One pound of air at sixty degrees is equal to thirteen cubic feet. Then one-thirteenth of a heat unit will heat one cubic foot of air one degree.

(4789) F. W. Q. asks whether he can get the same amount of electricity from a battery by immersing the zinc half way into the solution instead of all the way; as, for instance, in the Grenet battery described in SCIENTIFIC AMERICAN SUPPLEMENT, No. 157. A. By immersing the zinc one half way into the solution, you will get less current than you will if it is entirely submerged; the electro-motive force, however, will be the same in both cases.

(4790) A. P. J. asks what wash or prevention, if any, may be used to arrest powder posting in a chestnut bookcase. Fine powder issuing from small holes in the shelves is a constant annoyance. Reply by Prof. C. V. Riley.—Without having seen specimens of the author of the injury described by your correspondent, it is impossible to definitely determine the insect which is injuring his chestnut bookcase. There are several coleopterous insects of the family Ptinidæ which are notorious as infesting the hard wood used in the manufacture of desks,

household furniture, the handles of various implements, etc., and these are known as powder post beetles. Some of these belong to the genus Lyctus, of which *L. striatulus* is known to do similar injury to that described. These beetles are, however, more often found working outdoors, and the damage may be done by another common Ptinid beetle, the *Sitodrepa panicea*, which more often affects woods indoors and made into cabinets. The presence of these insects is always indicated by small circular holes, through which the beetles have entered the wood, or by small heaps of the dust which is pushed out by the burrowing larvæ. The beetles are small, of a brownish color, and their larvæ are small, six-legged, somewhat hairy, yellowish-white grubs, with their bodies more or less curved toward the extremity. Wood once thoroughly infested by the beetles or larvæ is beyond redemption; but in the case of the beginning of the injury, or as a preventive, washing, and if possible soaking, the wood in kerosene will act as a preventive and also destroy the beetles and larvæ as far as the oil penetrates. Where the wood is of such a nature that it can be submitted to stove or kiln heat without damage, it may be thus disinfected.

(4791) C. G. writes: I notice in SCIENTIFIC AMERICAN of March 4 a cut of a storage battery. Do I understand you as meaning that there are no zinc plates used at all? Is it simply sheet lead plates coated with red lead? Do I use same connections to charge battery as discharge it? Must the cell be air tight? How shall I know when it is charged? What book can I get to give me good knowledge on storage system complete? A. There are several different types of storage batteries. In many of the types both plates are formed of lead; no zinc is used, and the lead plates are coated with red lead. The same connections are used for charging and discharging the battery. The cell should not be air tight, as gases or vapors are generated which require a way of escape. For information on charging and using batteries, etc., we refer you to Salamon's "Electric Light Installations," price $2.

(4792) G. A. R. asks: What is meant by "ampere hour," so often referred to in battery circulars? Does it mean that the capacity is say (in a 50 ampere hour cell) 50 amperes for 1 hour, 1 ampere for 50 hours, or 10 amperes for 5 hours, etc.? Where can I obtain directions for making gas out of coal on a small scale, and the purifying of the same, storage, tanks, etc.? What power would a 6 foot windmill of the "air motor" pattern develop? A. One ampere hour is 1 ampere of current flowing for 1 hour, one-half an ampere of current flowing for 2 hours, one-tenth of an ampere flowing for 10 hours. On the other hand, 10 ampere hours may be 1 ampere for 10 hours or 10 amperes for 1 hour. We think of no small work on the manufacture of gas. We can refer you to "Gas Works: their Arrangement, Construction, Plant, and Machinery," by F. Colyer, price by mail, $8. The windmill to which you refer will probably average about one-half horse power.

(4793) O. J. asks: 1. In making fluid for bichromate batteries, do you add the sulphuric acid to water the first thing and then the bichromate potassium or bichromate potash to water and then sulphuric acid? A. The correct way to make the bichromate solution is to dissolve the bichromate first and afterward slowly add the sulphuric acid. 2. A recipe for a good luminous paint. A. For information on luminous paint, we refer you to SUPPLEMENT 497. 3. Is there any action on the zinc in a bichromate potash battery when the circuit is open? A. In the Fuller and Bunsen batteries there is scarcely any action on the zinc when the battery is not in use; but in plunging batteries the zinc, if left in the solution, is soon destroyed.

(4794) A. B. writes: I built the dynamo shown in SUPPLEMENT 900. Used it about three weeks on an arc light, when it burned out. Tried resistance in circuit, but it heated just the same and dimmed the light. Do arc light machines heat more than incandescent machines? Have a pair of field magnets like those shown in SUPPLEMENT 900. Can't I make a two horse power machine by making the following changes? Place a piece of iron one-half inch thick between the polar yokes (where the pole pieces are bolted together) and face off the bottom of the poles, and add an inch thickness to each one, and then bore out to about 4½ inches, taking care to throw the hole as much down as possible. The object of the pieces is to save stock. I would then wind ten layers of No. 16 wire on each pole in five pieces, each piece forming two layers, and add a shunt of fine wire on the outside, making a compound winding. Am sure the field could be made strong enough this way, even for a three horse power machine. What size wire should I use on armature say for about 60 volts? and how many coils ought there to be? Would there be any advantage in making the rings with four holes on the sides for ventilation? A. In regard to your arc light, we would suggest that you adjust the lamp so as to give a longer arc, thus increasing the resistance of the circuit. If this does not prevent the overheating of the armature, add 15 or 20 ohms resistance to the circuit and run the dynamo at a little higher speed. There is no reason why an arc light machine should heat more than an incandescent one if it is constructed for arc lighting. You could arrange your field magnet for a larger armature in the manner proposed. We cannot, without considerable calculation, furnish you the information you desire for the winding of your new armature. Probably your readiest way of getting at the matter is to see a machine of about the size desired and get your measurements from that. There will be an advantage in making ventilating holes in the armature, providing you do not cut out too much metal.

(4795) F. B. asks whether England or the United States produces the largest amount of steel now. A. The United States now produce the largest amount of steel, to wit, for 1890, 3,500,000 tons, Great Britain 3,250,000 tons.

(4796) H. A. asks: 1. What are the rules for finding the pitch of a propeller wheel? A. The pitch is obtained by multiplying the circumference in feet or inches by the cotangent of the angle of the blade with the center line. Or take the angle by opening a folding rule on the edge of the blade and in line with the shaft aft. Lay off two lines at right angles and place the angle of the rule on one line at a distance of the circumference of the wheel from the line representing the center of the shaft and extend the line represented by the opening of the rule to meet the central line. This forms a right angled triangle, of which the shaft line is the pitch in the same manner (feet or inches) that the circumference was taken in. 2. Does it require more power to run a boat at a certain rate of speed with a small propeller wheel than with a larger one? A. Yes. Propeller wheels should be as large as possible to run in solid water for economy. 3. How much pitch should a propeller have which is 14 inches in diameter, and how many revolutions should it make a minute to give a speed of 6 miles an hour to a shell boat, 16 feet long, with a very sharp bow, the boat weighing 230 pounds? A. A 14 inch screw for a boat with fine lines should have 30 inch pitch and make 275 revolutions per minute for 6 miles per hour, allowing 20 per cent slip. 4. When the pressure in a boiler is up at a certain point, say 70 pounds, does it require more fuel to keep it there than at a lower point of pressure? A. The amount of fuel required to keep the steam at a specified pressure depends entirely upon the power used. It takes more fuel for a given power at the lower pressure.

(4797) J. G. C. says: Will you please give a recipe for a paste that I can use on the face of a photograph, so I can mount the print face down on glass, something that will not discolor the face of the print and is not costly? A. To mount prints on glass follow the directions given by J. E. Dumont; that is, take 4 ounces gelatine and soak half an hour in cold water, then place in a glass jar, adding 16 ounces of water; put the jar in a large dish of warm water and dissolve the gelatine. When dissolved pour into a shallow tray. Have your prints rolled on a roller, albumen side out; take the print by the corners and pass rapidly through the gelatine, taking great care to avoid air bubbles. Hang up with clips to dry; when dry, squeeze carefully on to the glass. The better the quality of glass the finer the effect. From "The Scientific American Cyclopedia of Receipts, Notes and Queries."

(4798) A. S. writes: I would like to make a steam whistle, 12 inches diameter. What would be the proper length and what would the proportions be for a whistle one octave higher in tone than the 12 inch? A. A 12 inch whistle is usually made from 20 to 24 inches high. For an octave make the whistle about one-half the volume, subject to corrections for thickness of metal.

(4799) B. & T. ask: What will take off lampblack that is used in mortar and has got on the face of the brick? Our mason used muriatic acid and then put on linseed oil. What will clean it, if anything? A. Rub with a piece of pumice stone or sandpaper.

(4800) F. M. W. and others ask for a cement for use in making aquariums. A. Litharge, fine, white, dry sand, and plaster of Paris, each 1 gill; finely pulverized resin, ½ gill. Mix thoroughly and make into a paste with boiled linseed oil to which drier has been added. Beat it well, and let it stand four or five hours before using it. After it has stood for fifteen hours, however, it loses its strength. Glass cemented into its frame with this cement is good for either salt or fresh water. It has been used at the Zoological Gardens, London, with great success. It might be useful for constructing tanks for other purposes or for stopping leaks. Or take linseed oil, 3 ounces; tar, 4 ounces; resin, 1 pound; melt together over a gentle fire. If too much oil is used, the cement will run down the angles of the aquarium. To obviate this it should be tested before using by allowing a small quantity to cool under water. If not found sufficiently firm, allow it to simmer longer or add more tar and resin. The cement should be poured in the corners of the aquarium while warm (not hot). This cement is pliable, and is not poisonous. Paraffine applied to the bottom, if it is of wood, will make it waterproof. Have the wood dry and very hot; rub the paraffine in thoroughly.

(4801) B. W. P. says: Will you inform me whether any kind of grapes may be used to make raisins? A. No. The Muscatel is the principal grape grown to make the raisin, and its flavor excels that of all other varieties. For many years Malaga, Spain, has produced the best fruit, and previous to the introduction of Muscatel cuttings into California, our supplies were brought from that port. There is a difference of opinion in regard to the quality of the fruit produced in Malaga and California, the people in the far West claiming the latter to be superior; but unbiased experts consider the former superior in flavor, richer in sugar, more tender, and larger fruit.

(4802) H. N. says: I want to know what will be the pressure per square inch when air is compressed to one-half its natural bulk or size. Also what the pressure when pressed to one-third of its natural bulk. Would there be any difference if the quantity were large or small? A. For ordinary practical purposes, if the air is to be measured at a uniform temperature (isothermal compression), and calling the atmospheric pressure equal to 15 pounds the formula, pressure × volumes = pressure = the pressure of compression. Taking your inquiry, 15 × 2 = 30 − 15 = 15 pounds pressure and 15 × 3 = 45 − 15 = 30 pounds pressure. This will not be the pressure at the instant of compression, because the heat generated by compression expands the air, and at the moment of leaving the cylinder it may have a pressure of 20 pounds in the first case and 50 pounds in the latter. With water-jacketed cylinders, much of the heat of compression is absorbed and the final pressure drops nearer to the isothermal line. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 790, on air compression.

(4803) N. G. writes: About twelve miles from here is a very large spring. I think it must be about one thousand feet higher than this place. A mountain (or hill) higher than the level of the spring lies between us. Which do you think would be the best and cheapest means of conveying water to this city—by siphoning it from that spring, over the hill to a reservoir here, or by pumping it with steam from a river that runs through this place to a reservoir about one mile distant? Also please tell me where would be the best place to send my son to get a thorough knowledge of machinery, both steam and electric. A. If the flow from the spring is large enough for your city supply, it will be the best and cheapest water supply, considering the expense of pumping. A siphon of 10 or 15 feet lift might be made available, but will have to be often relieved of accumulating air. For siphon, any height above 15 feet could not be made practicable in so long a line of pipe. You do not give details enough for the best advice. It is worth your while to have a survey made as to the whole grade and ascertain whether a detour could be made for a gravity flow. If the water in the river is good, a large ram with a fall of 4 or 5 feet would make an economical water supply. Steam is a constant expense. Perhaps windmills could be used. The Rose Polytechnic Institute, Terre Haute, Ind., is one of the best schools in mechanical and electric engineering in the West, also the Vanderbilt University, Nashville, Tenn.

(4804) J. E. S. writes: 1. I have a well 140 feet to water, which is inexhaustible. By going 40 feet deeper we find dry sand, which absorbs all the water unless pingged below the water line, or we stop drilling before we get through a very hard rock that lies directly on top of the dry sand bed. Can I raise the water with a hydraulic ram? Give instructions for putting in. If not, is there an automatic apparatus that will raise the water? A. You cannot raise water from bored well with a ram, unless by enlarging it, you can sink a pipe through to the absorbing stratum below, to carry off the water used to work the ram and create the necessary pressure. There are oil and gasoline engines and air engines used for pumping water from wells. They all require care. A windmill will be the best automatic machine. 2. Does the moon revolve on an axis as the earth does? If so, why is it the same spots face us all the time? A. The moon makes one revolution on her axis in the same time that she makes one revolution around the earth, and that is the reason why the same parts face us all the time. 3. What shades the moon or causes its different phases? A. It is the reflection of the sun's light on the moon that makes her appear to vary in form. 4. How near has any of the heavenly bodies ever been to the earth, and what is the nearest to the earth at present? A. The moon is the nearest heavenly body. She is 240,000 miles distant from the earth. 5. What body or bodies will cause the eclipse of the sun April 16 and October 9, and their distance from the earth? A. The moon coming between the sun and the earth produces an eclipse of the sun.

(4805) C. M. H. says: I have a steam vacuum irrigating pump which draws water through an 8 inch pipe from a river 18 feet below. My supply pipe now runs diagonally from the pump into the stream, and as the pump is set some distance back from the edge, the supply pipe is necessarily 54 feet long. Will the lift of the water be less if I cut a ditch from the river to a point directly underneath the pump and run my pipe vertically down? If so, how much less will be the weight of the water? A. The weight of the water in the suction pipe is due to its vertical height only. There will be no difference in the pull of the pump due to the two positions alone. The vertical pipe will have less friction than the inclined pipe, as well as less volume, and will require less power to overcome its inertia at the change of stroke in the pump, unless the vacuum pump is of a kind that will keep the water in the long suction pipe under a constant and equal velocity. As this is doubtful, and the possibility that the friction may add a foot, more or less, to the suction head, we advise the open ditch and vertical suction.

(4806) E. J. A. writes: We have a building 16 feet square, 16 feet posts, tight. We wish to place steam pipes in this for the purpose of drying slack barrel heading. We would ask: Our boiler is 25 horse power. Engine uses (develops) but 5 or 8 horse power. Will that not leave boiler steaming capacity to make plenty of steam for this size kiln? We have excellent fuel. Boiler and engine are about 60 feet from kiln building. Will we lose much heat, piping this distance, if we lay pipe in ground, using asbestos packing? What size pipe, to use live steam, would we need, and how many feet, in building, to develop all the heat possible, as there is not much danger heating the material too fast or too much, so as you don't burn it up? Do you think it practical to use steam for drying? We want to develop 150° or 160° of heat in kiln if we can. Boiler pressure 80 pounds. A. You can make a good drying room with the spare steam that you have, without waste of heat. The steam pipe should be thickly felted and the line underground laid in a box 8 inches clear inside, with 1¼ inch pipe well felted and supported in the center. Pipe in the drying room should be in flat coils under a lattice floor, 2,000 feet of 1 inch pipe, laid in sections so that it will clear itself of water. The heading should be piled in racks above the floor. The condensed steam should be led back, through a pipe in the box and returned to the boiler.

(4807) W. T. P. writes: I would like information how to build a breast or current water wheel and to gear same to run centrifugal pump. I want to raise anywhere from twelve hundred to twenty-four hundred gallons per minute of time fifteen feet high for irrigation purposes. I want to know the length of wheel and diameter and how to gear wheel so it would adjust itself to rise and fall in river and how to prevent drift from injuring wheel in river. I have abundance of water in river to get the power, if I could get some way to utilize the power in the river. A. You will require a wheel of about 15 horse power. You will find the wheel that you describe illustrated and described in SCIENTIFIC AMERICAN, January 21, 1893, 10 cents mailed. This form of wheel will have to be constructed to suit the velocity of current or the height of the breast. A millwright or clever carpenter should be able to build a wheel to suit the power required.

(4808) L. W. S. asks: 1. When does the patent on the Bell telephone receiver expire? A. The patent on the Bell telephone receiver expires in January, 1894. 2. In making one of the above telephones, would No. 36 wire be better than 36, when the telephone is to be used on a line two or three miles in length? A. No. 38 would be better for use than No. 36, but it is more difficult to wind. 3. Is it the resistance in the line wire that causes telephones to fail on long distances? A. The failure of the telephone on long distances is due to leakages more than to resistance.

(4809) H. V. F. asks: 1. Does the telephon, described in SCIENTIFIC AMERICAN SUPPLEMENT, No. 142, need any battery? A. No. 2. Will the telephone work on a line 450 feet long? A. Yes. 3. What size of copper wire should I use? A. No. 18 will answer for the distance given. 4. Will the above suffice if I use the telephone call in Fig. 5 on page 2271 in SCIENTIFIC AMERICAN SUPPLEMENT, No. 142? A. Yes. 5. Shall I use return wire or return through the earth? A. Either return will answer.

(4810) M. J. B. asks the size of stack that should be put on dry kiln, size of which is 62 feet by 27 feet by 7 feet, and containing 5,000 feet of steam pipe. We would like to remove the air out of the room about every ten minutes. A. Assuming the steam pipes are on or near the floor and the lumber piled above the pipes, the ventilation in so large a floor space should be divided so as to make an even flow of air throughout the room. For this purpose at least six uptakes should be made through the ceiling, 18 inches square, equally dividing the area of the ceiling. These uptakes need be no more than 8 or 10 feet high, with hoods to keep out rain, and dampers, so that they may be closed when steam is first turned on.

(4811) A. F. writes: Are the numbers by which the different sizes of electric wires are called arbitrary numbers or do they refer to measures, fractions of inches, etc.? Suppose that for making a telephone you say that No. 18 wire is used, how can I convert that number in millimeters, as the diameter of wires is given in that measure? A. The numbers of the American wire gauge are arbitrary. For this reason you will have to get the sizes in mills or circular mills from some of the existing tables. You will find such a table in Sloane's "Arithmetic of Electricity," price by mail $1.

(4812) N. H. E. asks the cheapest and best way to color brass black. A. Dip the clean brass in a solution of chloride of platinum.

(4813) W. B. R. asks how lead pipes are joined together by the use of a blow pipe. A. For soldering lead pipes with a blow pipe, a jump joint is made by opening one end bell mouth and scarfing the other end to fit in, when, by powdering the joint with rosin and placing a piece of strip solder around the joint, it can be heated by a blow pipe until the solder runs in and makes the joint.

(4814) W. E. H. writes: Please give the process for etching brass signs. Also the japan or black material used to fill in with. A. The brass sign is painted all around the letters with asphalt varnish and a wall of putty or soft asphalt raised outside the lettering to keep the acid from flowing away. Use nitric acid 1 part, water 2 parts, mix and pour on the plate to a depth of ⅛ inch. When bitten deep enough, wash dry and fill with melted asphalt or black sealing wax.

(4815) C. C. M. asks: Can you give us any information about the use of aluminum for shoeing race horses? We have tried it, but find the metal too soft. Is there any way to harden it? A. As we assume that your object is to make a light shoe, we recommend an alloy of from 3 to 5 per cent of copper to aluminum. This will make the aluminum slightly heavier, but harder and tougher. Probably the 3 per cent alloy will be all that is required.

(4816) T. T. asks: In firing a cannon, at what point will its projectile attain its greatest velocity? Also, how is the velocity of projectiles measured? A. The velocity of a shot is greatest at the muzzle of the gun.

(4817) J. G. W. writes: I am making a quantity of very light castings with a core inside. The castings want to be very soft, so as to drill and tap easily. No strength is required. I find that while I have the iron soft enough on the outside, the core seems to chill the iron somewhat on the inside, thus making it hard on the tap. The core is made of boiled oil, resin, and moulding sand in certain proportions. What I want to know is this: Is there any formula for making cores that has a softening effect at the junction of the iron with the core? A. For cores try new mouldings, and mixed with as little paste as will allow the sand to hold together, and bake thoroughly dry in an oven.

(4818) M. B. writes: I have to arrange a calendar for 1894, but have no tables from which I can find the time for the rising and setting of the moon for every day and in different places. Can you give me some information regarding such tables? A. The Nautical Almanac gives the moon's position for every day in the year, with the necessary formulas. It is published by the government at Washington.

(4819) F. B. says: I want a receipt for a paint to apply to a copper-lined bath tub from which the tin has been worn in patches. I would prefer some white color. A. Use ordinary white paint.

(4820) J. H. H. asks: 1. How can I mix bronze powder in a liquid form? With what can I cut it? A. Mix the bronze powder in thin mastic varnish. 2. What size and how many blades should a propeller wheel be to propel a 13 foot canoe? A. A two-blade screw 10 inches diameter for the canoe.

(4821) J. C. R. writes: I am building a small non-condensing compound marine engine of the following dimensions: Diameter of cylinders, H. P. 9¼ in., L. P. 1¼ in., stroke ¾ in., size of ports H. P. cylinder 1-16×3-16, exhaust 3-32×3-16, L. P. cylinder 1-16×9-32, exhaust 3-32×9-32. Are the cylinders and ports in the proper proportion? If not, give size of L. P. cylinder. If the cranks are fixed at right angles to each other, give relative position of eccentrics to cranks. A. The cylinders are a good proportion, as are also the ports. The longer diameter of the eccentrics should be slightly ahead of a line at right angles to the crank. See "Model Engine Making," by Pocock, $1 mailed.

(4822) J. H. R. writes: I wish to lay out my yard in walks. I do not care for brick, but a preparation to put on the ground. Now is there any cement or preparation similar to cement that will stand freezing? And if there is, can you give me cost per square foot or yard? A. Probably hydraulic cement mixed with sand, 1 of cement to 2 of sand, makes as good walks as anything that you can handle. The cement is about $1.35 per barrel, and 1 barrel should make about 4 square yards of walk 1 inch to 1½ inch thick. Mix dry, and wet and spread quickly. Smooth with a trowel.

(4823) S. Z. asks for a solution for plating metal goods a jet black, that will not peel or crack when said goods are squeezed. A. The coloring of the surface of metals black may be done by chloride of pla-

tinum and other receipts in our "Cyclopedia of Receipts," but do not stand squeezing or pressing, without marking the surface. Such surface color should be done after finishing.

(4824) **F. W. C. says:** I am desirous of knowing how to make aluminum present a matted appearance, such as would look well in jewelry. Also, if there is a better material to polish aluminum than rouge. A. The matting of aluminum is done with polished matting tools or stippled with a bread lining or stipple, the same as silver plate. The tools can be obtained from dealers in jewelers' tools. For the bright finish on aluminum, use Vienna lime after the rouge.

(4825) **J. T. asks how far a 124 ton gun** will throw a projectile, the kind Krupp will exhibit at the World's Fair, also the quantity of explosives to fire each round. A. The 124 ton gun is intended to carry solid shot of half a ton with a charge of 700 pounds of powder, with a range of 12 or 13 miles.

(4826) **C. E. E. asks:** What can I use for the porous cup in a battery? What will do that I can find here without buying one? A. Porous flower pots may be used for the porous cells of batteries by stopping the hole in the bottom of the pot. Such porous cells, however, are not as efficient as those made for the purpose.

(4827) **S. B. write:** We have two large iron columns, one on each side of boilers, in basement, both essential supports to a six story building. They get very hot. Will you please advise us if expansion and contraction of same is any indication of danger? A. There is no danger, from the influence of the heat, if the columns are outside of the brickwork of the boiler setting.

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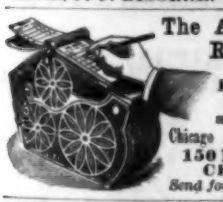

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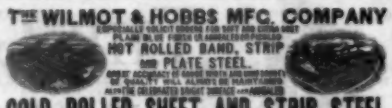

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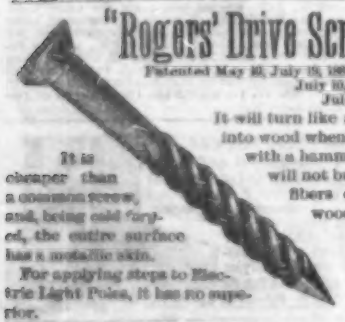

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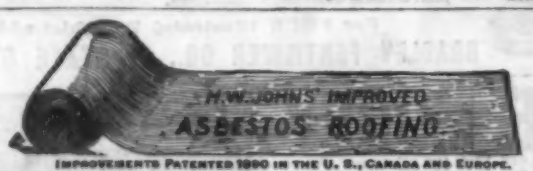

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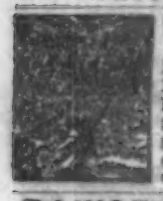

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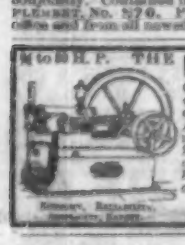

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